Health and disease status of Australia's most critically endangered mammal the Gilbert's potoroo 
(Potorous gilbertii)

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A dissertation submitted to Murdoch University in fulfillment of the requirements of a Doctor of Philosophy.

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“The aim of conservation medicine is ultimately to develop a solution-oriented, practice-based approach in addressing health problems derived from environmental change. This builds upon existing knowledge frameworks in wildlife health, public health, epidemiology, ecology, conservation biology, and veterinary science. By working at a larger scale of perspective, conservation medicine provides more specialized disciplines to interact in a more effective manner. In this way, conservation medicine employs concepts of ‘consilience’ by bringing together disciplines long separated by time and tradition” (Daszak 2004).

This thesis is presented as an applied research project embodied within the above framework. It represents a working example of Daszak’s four guiding elements of conservation medicine constituting; interdisciplinary interaction, individual collaboration, institutional cooperation and innovative investigation (Daszak 2004).
I declare that this thesis is my own account of my research and contains as its main content, work which has not been previously submitted for a degree at any tertiary education institution.

Dr Rebecca Vaughan BSc BVMS

June 2008.
Acknowledgements:

This thesis is the result of extensive field work and laboratory investigation which would not have been achieved without the support and contributions of the people below.

Dr Tony Friend, Stephanie Hill and Tim Bunton from the Department of Environment and Conservation (DEC) in Albany who manage the ongoing recovery of the Gilbert’s potoroo in the Two Peoples Bay Nature Reserve as well as Val Hack and other members of the Gilbert’s potoroo action group (GPAG). I would like to acknowledge the time, ongoing dedication and effort of the Albany DEC staff and GPAG volunteers, for assistance in trapping, sample collection, processing, transport and friendship. It has been a pleasure to work with you all.

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My supervisors, Dr Kristin Warren, Dr Stan Fenwick and Dr Cree Monaghan. Thankyou so much for all your assistance and enthusiastic support throughout this project. In particular I would like to thank my principal supervisor Kris, who was always available to bounce ideas off, visited me in the field and provided me with help ‘above and beyond’ the call of duty. Kris highlighted the importance of this project from the early days and strove for funding and in doing so managed to secure the bulk of testing at no cost. Through her numerous contacts in conservation medicine and the DEC, Kris was able to ensure this project became a reality and evolved into what is undoubtedly one of the first comprehensive health and disease studies of an endangered marsupial species in Australia. In my 3rd year of my undergraduate veterinary degree Kris also provided me with the inspiration to pursue a wildlife and exotic animal veterinary career. This inspiration led me to then pursue a combined residency in zoo and wildlife medicine and a PhD, a decision I have never looked back upon.
My partner, Ben Higgins is to be thanked for endless proofreading, support and for understanding the importance of this project to me and conservation medicine.

Finally, I would like to thank my family; Dad, Mum, John, Lisa, Michael, Violet, Suzannah, Peter and Sara for always supporting me to achieve my goals, whatever they may be.

Abstract:

The Gilbert’s potoroo (Potorous gilbertii) is a small marsupial endemic to the Two Peoples Bay Nature Reserve in the south-west of Western Australia. The Gilbert’s potoroo is classified as Australia’s most critically endangered mammal (IUCN 2006) with an estimated population of only 35 individuals. This thesis examines the health and disease status of the Gilbert’s potoroo, presenting a strong case for the relatively new concept of disease as a potential threatening factor and modifier of population decline.

Specific diseases, including Cryptococcus, ectoparasitism, endoparasitism, haemoparasitism, Toxoplasma and a novel Treponema organism are extensively studied. An assessment of the clinical significance of these diseases is made, and management strategies are recommended to minimise the impact of these diseases on both the wild and captive population.

The novel Treponema organism which clinically presents with tenacious, green discharge and an associated balanoposthitis in males is molecularly characterized. Epidemiological studies show the effects of this agent on reproductive function and a penicillin-based treatment regime is trialled in the analogous long-nosed potoroo (Potorous tridactylus) with a recommendation to then trial this treatment regime in the critically endangered Gilbert’s potoroo.
Standard haematological and urinalysis findings are tabulated to form reference ranges for this species. A treatment regime for Cryptococcus in the analogous long-nosed potoroo is reported and parasitological findings, including the identification of a novel tick species are discussed.

This thesis addresses key health issues, which have subsequently been incorporated into the Recovery Plan of the Gilbert’s potoroo. A document encompassing multiple disciplines and expertise to support the recovery of this critically endangered marsupial in its current environment. In addition, this thesis outlines a recommended health monitoring and treatment protocol for future translocation procedures and provides a working example of the emerging importance of health monitoring in threatened species recovery programs.

**Publications:**

**Scientific publications arising from this research:**


Three manuscripts are currently in preparation.
Conference presentations:


Radio interviews and media reports:


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<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AARL</td>
<td>Australian Rickettsial Reference Laboratory</td>
</tr>
<tr>
<td>Ab</td>
<td>antibody</td>
</tr>
<tr>
<td><em>Aepyprymnus rufescens</em></td>
<td>rufous-rat bettong or rufous-rat kangaroo</td>
</tr>
<tr>
<td>Ag</td>
<td>antigen</td>
</tr>
<tr>
<td>AGT</td>
<td>alanine-glyoxylate aminotransferase</td>
</tr>
<tr>
<td>Al</td>
<td>artificial insemination</td>
</tr>
<tr>
<td>ALP</td>
<td>alkaline phosphatase</td>
</tr>
<tr>
<td>ALT</td>
<td>alanine aminotransferase</td>
</tr>
<tr>
<td>ANOVA</td>
<td>analysis of variance</td>
</tr>
<tr>
<td><em>Antechinus flavipes</em></td>
<td>yellow-footed antechinus</td>
</tr>
<tr>
<td><em>Antechinus stuartii</em></td>
<td>brown antechinus</td>
</tr>
<tr>
<td>ARKS</td>
<td>animal record keeping system</td>
</tr>
<tr>
<td>AST</td>
<td>aspartate aminotransferase</td>
</tr>
<tr>
<td><em>Bettongia gaimardi</em></td>
<td>eastern bettong</td>
</tr>
<tr>
<td><em>Bettongia lesuer</em></td>
<td>burrowing bettong</td>
</tr>
<tr>
<td><em>Bettongia penicillata</em></td>
<td>brush-tailed bettong</td>
</tr>
<tr>
<td>b.i.d</td>
<td>twice daily</td>
</tr>
<tr>
<td>BFP</td>
<td>biological false positives</td>
</tr>
<tr>
<td>C</td>
<td>captive</td>
</tr>
<tr>
<td>°C</td>
<td>degrees celcius</td>
</tr>
<tr>
<td>CALAS</td>
<td>Cryptococcal Antigen Latex Agglutination System</td>
</tr>
<tr>
<td>CBC</td>
<td>complete blood count</td>
</tr>
<tr>
<td>CDC</td>
<td>Center for Disease Control and Prevention</td>
</tr>
<tr>
<td>CI</td>
<td>confidence interval</td>
</tr>
<tr>
<td>chip</td>
<td>microchip</td>
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</table>
CK  creatine kinase
cm  centimetre
CNS  central nervous system
CO₂  carbon dioxide
CODD  contagious ovine digital dermatitis
CSF  cerebrospinal fluid
DAFWA  Department of Agriculture and Food Western Australia
*Dasyurus geoffroii*  western quoll
*Dasyurus hallucatus*  northern quoll
DAT  Direct agglutination test
DD  digital dermatitis in cattle
DEC  Department of Environment and Conservation
*Dendrogalus matschiei*  Matschie’s tree kangaroo
*Dendrogalus ursinus*  black-tree kangaroo
DFM  dark field microscopy
*Didelphis marsupialis*  American opposum
DNA  deoxyribonucleic acid
dNTPs  deoxynucleotide triphosphates
EDTA  ethylenedinitrilotetraacetic acid
EENT  ear, eyes, nose and throat
EIA  Enzyme immunoassay
ELISA  Enzyme-linked immunosorbent assay
ET tube  endotracheal tube
F  female
g  gram
*g  gravity force
G  gauge
GNR  Gram-negative rod
GP    Gilbert’s potoroo
ha    hectare
H&E   Haematoxylin and Eosin
HIV   Human immunodeficiency virus
hpf   high power field
HR    heart rate
*Hypsiprymnodon moschatus*    musky-rat kangaroo
ID    identification
IFA   Immunofluorescence antibody
IgG   Immunoglobulin G
IgM   Immunoglobulin M
IHC   Immunohistochemistry
IM    Intramuscular
*Isoodon macrourus*    short-nosed, northern-brown, or golden bandicoot
*Isoodon obesulus*    southern-brown bandicoot
IU    International Units
IUCN  World Conservation Union
IV    Intravenous
Juv   juvenile
km    kilometre
L     litre
LCAT  Latex cryptococcal antigen test
M     male
*Macropus agilis*    agile wallaby
*Macropus antilopinus*    antelopine kangaroo
*Macropus bennetti*    Bennett’s wallaby
*Macropus dorsalis*    black-striped wallaby
*Macropus eugenii*    tammar wallaby
<table>
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<th>western-grey kangaroo or kangaroo-island kangaroo</th>
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<td><strong>Macropus giganteus</strong></td>
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<td><strong>Macropus giganteus melanops</strong></td>
<td>black-faced kangaroo</td>
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<td><strong>Macropus irma</strong></td>
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<tr>
<td><strong>Macropus rufus</strong></td>
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<td><strong>MAT</strong></td>
<td>Modified agglutination test</td>
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</tr>
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<tr>
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<tr>
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<td>number</td>
</tr>
<tr>
<td><strong>NAD</strong></td>
<td>no abnormalities detected</td>
</tr>
<tr>
<td><strong>neg</strong></td>
<td>negative</td>
</tr>
<tr>
<td><strong>NSAID</strong></td>
<td>non-steroidal anti-inflammatory drug</td>
</tr>
<tr>
<td><strong>OIE</strong></td>
<td>World Organization for Animal Health</td>
</tr>
<tr>
<td><strong>p</strong></td>
<td>p-value or probability value</td>
</tr>
<tr>
<td><strong>PHA</strong></td>
<td>Mitogen driven proliferation assays</td>
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<tr>
<td><strong>pos</strong></td>
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</tr>
<tr>
<td><strong>py</strong></td>
<td>pouch young</td>
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<tr>
<td><strong>PBS</strong></td>
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<tr>
<td><strong>PCR</strong></td>
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<tr>
<td><strong>Perameles bougainville</strong></td>
<td>western-barred bandicoot</td>
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<tr>
<td><strong>Perameles gunnii</strong></td>
<td>eastern-barred bandicoot</td>
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</table>
Petaurus breviceps   sugar glider
Petrogale penicillata  Victorian brush-tailed rock wallaby
PHS  Potoroo hyperoxaluria Syndrome
PO  oral route
Pseudocheirus peregrinus  ringtail possum
Onychogalea fraenata  bridled nail-tail wallaby
Onychogalea unguifera  northern bridled nail-tail wallaby
OR  odds ratio
Ornithorhynchus anatinus  platypus
Permales nasuta  long-nosed bandicoot
Petrogale brachyotis  short-eared rock wallaby
Petrogale concinna  pygmy rock wallaby
Petrogale herberti  Herbert’s rock wallaby
Petrogale inornata  unadorned rock wallaby
Petrogale penicillata  brush-tailed rock wallaby
Petrogale persephone  Proserpine rock-wallaby
Phascolarctos cinereus  koala
Potorous gilbertii  Gilbert’s potoroo
Potorous longipes  long-footed potoroo
Potorous tridactylus  long-nosed potoroo
q24hr  every 24 hours
RBC  red blood cell
RNA  ribonucleic acid
rRNA  ribosomal RNA
rpm  resolutions per minute
RPR  Rapid plasmid reagin
RR  respiratory rate
Schoinobates volans  marsupial glider
Setonix brachyurus  quokka
s.i.d  once daily
SC  Subcutaneous
Sminthopsis murina  slender-tailed dunnart
sp.  species (singular)
spp.  species (plural)
Tachyglossus aculeatus  short-beaked echidna
Tarsipes rostratus  honey possum
TBE  Tris/Borate/EDTA
Thylogale billardierii  Tasmanian pademelon or rufous-bellied pademelon
Thylogale stigmatica  red-legged pademelon
t.i.d  three times daily
TPPA  Treponema pallidum particle agglutination
Trichosurus caninus  mountain brushtail possum
Trichosurus vulpecula  brushtail possum
µg  microgram
US  United States
UTI  urinary tract infection
UV  ultra-violet light
V  volts
VDRL  Venereal Disease Research laboratory
VGI  Cryptococcus gattii (molecular type I)
VGII  Cryptococcus gattii (molecular type II)
Vombatus ursinus  wombat
W  wild
WA  Western Australia
Wallabia bicolor  swamp wallaby or black wallaby
Wallabia eugenii  tammar wallaby

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WBC    white blood cell