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**An investigation of *Leucocytozoon*
in the endangered yellow-eyed penguin
(*Megadyptes antipodes*)**



A thesis presented in partial fulfilment of the requirements for
the degree of
Master of Veterinary Science
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Abstract

Yellow-eyed penguins have suffered major population declines and periodic mass mortality without an established cause. On Stewart Island a high incidence of regional chick mortality was associated with infection by a novel *Leucocytozoon* sp. The prevalence, structure and molecular characteristics of this *leucocytozoon* sp. were examined in the 2006-07 breeding season. In 2006-07, 100% of chicks (n=32) on the Anglem coast of Stewart Island died prior to fledging. Neonates showed poor growth and died acutely at approximately 10 days old. Clinical signs in older chicks up to 108 days included anaemia, loss of body condition, subcutaneous ecchymotic haemorrhages and sudden death. Infected adults on Stewart Island showed no clinical signs and were in good body condition, suggesting adequate food availability and a potential reservoir source of ongoing infections. A polymerase chain reaction (PCR) survey of blood samples from the South Island, Stewart and Codfish Island found *Leucocytozoon* infection exclusively on Stewart Island. The prevalence of *Leucocytozoon* infection in yellow-eyed penguin populations from each island ranged from 0-2.8% (South Island), to 0-21.25% (Codfish Island) and 51.6-97.9% (Stewart Island). The high prevalence on Stewart Island represented the infection of 100% of chicks and 83% of adult yellow-eyed penguins when tested by PCR. Sequencing of *Leucocytozoon* sp. DNA found similarities between infections in yellow-eyed penguin adults and chicks, but differences to *Leucocytozoon* sp. DNA obtained from Fiordland crested penguins. These findings support the suggestion of cross infection between adults and chicks, and indicate that endemic infection in yellow-eyed penguins is unrelated to that in Fiordland crested penguins. Examination by histology and electron microscopy showed tissue megaloschizonts and circulating round

gametocytes. Megalochizonts up to 440µm diameter showed an affinity for hepatic and splenic tissue and were observed releasing occasional intact cytomeres. Round gametocytes were observed within leucocytes in visceral sections, but not peripheral blood smears. The morphology of *Leucocytozoon* sp. in yellow-eyed penguins showed similarities to the pathogenic species *L. simondi* and *L. sakharoffi* but not *L. tawaki*. A successful treatment protocol for leucocytozoonosis has not been established, although treatment in a Fiordland crested penguin was able to suppress parasitaemia. The role of *Leucocytozoon* in yellow-eyed penguins as a cause of morbidity and mortality remains unclear. Further investigation into direct pathogenicity, and the interaction of concurrent disease and environmental influences is required. The findings of this thesis provide potential management recommendations and highlight areas requiring further investigation.

Declaration

The studies presented in this thesis were completed by the author whilst a postgraduate student in the Institute of Veterinary, Animal and Biomedical Sciences, Massey University. I officially state that this is my own work and the views presented are mine, and that the contents have not been submitted for any other degree. I certify that to the best of my knowledge any help received in preparing this thesis and all sources used have been acknowledged in the thesis

Andrew Hill

Supervisor

Brett Gartrell

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The content and structure of this thesis

This thesis documents the ongoing investigation of a new species of *Leucocytozoon* identified in the yellow-eyed penguin on Stewart Island in 2005. Its prevalence, structure and implications are explored.

The structure of this thesis consists of 3 parts, a summary of current knowledge regarding *Leucocytozoon* and yellow-eyed penguins; a series of 3 scientific papers, as presented for publication, detailing the investigation of *Leucocytozoon* in yellow-eyed penguins and its neighbour, the Fiordland crested penguin; and a discussion of the findings of this research and its impact on the yellow-eyed penguin.