An investigation of the causes of mortality in yellow-eyed penguins *(Megadyptes antipodes)* across their range with specific emphasis on the role played by *Leucocytozoon.*

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Lisa Shelley Argilla

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Abstract

Over the past 40 years, there have been frequent mass mortality events documented in yellow-eyed penguins *(Megadyptes antipodes).* In most cases, these mortality events have resulted in significant adult or chick mortality resulting in a population decline. Previous studies in yellow-eyed penguin mortality have been attributed to events such as unidentified phytotoxins, starvation, poor nutrition, climatic events and infectious causes. However, the full impact of these factors on yellow-eyed penguin population decline and mortality events is not well understood. During the Austral summer of 2008/09, there were mortality events documented in both the subantarctic and mainland yellow-eyed penguin populations with different patterns of mortality and different factors associated with the mortality between both locations. A high overall prevalence of *Leucocytozoon* spp. in association with a high incidence of chick mortality was observed during this period on Enderby Island. Despite its endemic nature in this population, statistical analysis demonstrated that infection with *Leucocytozoon* did not play a significant role in mass mortality of Enderby Island chicks, other than as a cause of sporadic individual mortality. The *Leucocytozoon* spp. sequences detected lead to the conclusion that the *Leucocytozoon* parasite is endemic in yellow-eyed penguins and has a higher prevalence in penguins from Enderby Island than those from Campbell Island and the mainland of New Zealand. The Enderby Island yellow-eyed penguins are infected with a *Leucocytozoon* spp. that is genetically distinct from that found in other yellow-eyed penguin populations. The role of *Leucocytozoon* in the high levels of chick mortality in the yellow-eyed penguins remains unclear. A very low mortality was observed in the Catlins population despite there being a high level of human impact at some nest regions within this location. A high level of mortality was described in the Otago Peninsula population with this population affected by high human disturbance from tourism, reduced quality of breeding habitat, diphtheritic stomatitis as well as increased environmental temperatures during the study season. All of these factors played a significant role in mortality of chicks at this location. Results from this research provide the foundation for future investigations into the risk factors for mortality in yellow-eyed penguins across their range as well as providing a basis for sound management and veterinary advice to assist with conservation of this endangered species.

Preface

This thesis documents the ongoing investigation of a new species of *Leucocytozoon* which was first identified in yellow-eyed penguins *(Megadyptes antipodes)* on Stewart Island in 2005. It documents the unexpected finding of a high prevalence of this parasite in the subantarctic population of yellow-eyed penguins and its effects on the population. This thesis also explores the risk factors contributing to mortality of yellow-eyed penguins in three major breeding areas during a mortality event that occurred in both the subantarctic and mainland population during the 2008/09 breeding season.

The structure of this thesis consists of 4 chapters; a summary of current knowledge of yellow-eyed penguins, *Leucocytozoon* and mortality events in yellow-eyed and other penguin species (Chapter 1) a series of 2 scientific papers, with the first, published in the journal of Parasitology, documenting the finding of *Leucocytozoon* in the subantarctic yellow-eyed penguin population (Chapter 2). The second documents the investigation that took place in three breeding locations during a mortality event in the 2008/09 breeding season (Chapter 3). Finally, a general discussion (Chapter 4) of the findings of this research and future implications and recommendations for this endangered penguin.

The reference list from each chapter has been condensed into a single bibliography which is presented at the end of the thesis.

The research was carried out under the following permits: DOC banding permit: Enderby/Campbell 2006-2008 – SO-17933-FAU, Enderby 2008-09 –DOC AE permit # 175, Research permit for subantarctic island – permissions database number SO-17658-RES (Invercargill permit # 0506-14); Massey University Animal Ethics permit MUAEC 08/91

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Last but certainly not least, thank you to my family and friends for their understanding and support as I embarked on my mission of researching the rarest penguin in the world.

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