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**Parasitism, disease and breeding ecology  
of little blue penguins (*Eudyptula minor*) on  
Tiritiri Matangi Island, New Zealand**

A thesis submitted in partial fulfilment of the requirements for the degree  
of Master of Science in Conservation Biology  
Massey University, Auckland.

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*"A thing is complete when you can let it be."  
Gita Bellin*

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## ABSTRACT

According to the New Zealand Threat Classification, little blue penguin (LBP) (*Eudyptula minor*) populations are under 'gradual decline'. Although long-term data are available for some mainland populations, the status of LBP on offshore islands remains largely unknown. Most studies have focussed on breeding success and foraging ecology. However, there is a paucity of data pertaining to diseases and parasites, and the potential effects of these factors on LBP health, reproductive success and survival. To date, the LBP population on Tiritiri Matangi Island, Hauraki Gulf, Auckland, New Zealand, has only been monitored periodically, despite the island being an important habitat for LBP throughout their annual cycle. The overall aim of this study was to examine the relative importance of parasites and disease in relation to key aspects of LBP life-history, including: the annual cycle; reproductive success; energetic demands, immunity; and mortality.

During 2006 and 2007, the reproductive success of LBP on Tiritiri Matangi Island was investigated with respect to lay date, nest site attributes, parental quality and ectoparasite loads. A nest treatment experiment was conducted to explore flea (*Parapsyllus longicornis*) and tick (*Ixodes eudyptidis*) effects on breeding success. Overall reproductive output was low, estimated at 33.3%, with an average of 0.67 chicks fledged per pair. Lay date and body condition (BC) appeared to be the main drivers of reproductive success, with early breeders fledging significantly more chicks than late breeders. Increased BC improved reproductive success. Although late breeders exhibited higher BC scores, increased chick mortality indicated that late nests face a reproductive trade-off. Treatment did not prove effective in reducing ectoparasite loads and there was no correlation between ectoparasite abundance in the nest and reproductive success.

Throughout their geographic distribution, penguins are host to a range of ectoparasites. Using *Ixodes eudyptidis* ticks as indicators, ectoparasite-host dynamics were investigated over the course of one year, in relation to LBP life stages, body condition (BC) and haematological parameters. To investigate the presence of vector-borne diseases, blood parasite prevalence was determined using molecular techniques and microscopy. Tick load exhibited significant seasonal variation, being highest during periods of increased host availability i.e. moult and breeding. However, these increases in abundance were not associated with body condition or decreased reproductive success of adults. Nonetheless, LBP exhibited seasonal fluctuations in haematological parameters, with decreases in white blood cell concentrations during periods of increased energy demands and high tick loads.

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Blood parasite prevalence was low (<1%), determined to be *Plasmodium* sp. infection. No other blood parasites were found. These results indicate that the lifecycle of *I. eudyptidis* is tightly linked with that of its LBP hosts, and that infested individuals exhibit physiological responses to tick load.

LBP exhibit annual fluctuations in mortality and experience periodic mass mortalities. To examine factors associated with mortality, post-mortems were conducted on 32 LBP from the Hauraki Gulf. Additionally, 128 LBP necropsy records were obtained from the National Wildlife Database (HUIA) for the period spanning April 1993-January 2009, and the causes of mortality were reviewed. Starvation and disease accounted for the highest mortality levels, with 65% of deaths attributed to either one or both of these factors. Furthermore, there was a strong association between starvation and parasites. Parasitic disease and diseases of uncertain aetiology were the most common disease types. In all age groups, the likelihood of infectious, non-infectious and disease of unknown aetiology was significantly higher in LBP that harboured one or more parasite species. Results from this study suggest that starvation and disease, including parasites, are significant factors associated with mortality of LBP in New Zealand, as has been found in Australian LBP populations.

Parasites and disease are increasingly recognised as a challenge to the conservation of wildlife, and information regarding endemism of pathogens and parasites within populations is vital for determining ecosystem health, and identifying aberrant diseases.

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