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Assessing the impacts of infectious disease on reproductive success in New Zealand sea lions (*Phocarctos hookeri*)

A thesis presented in partial fulfilment of the requirements for the degree of

**Master of Veterinary Science**

in

**Wildlife Health**

at Massey University, Palmerston North, Manawatū, New Zealand.

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Abstract

Poor reproductive success is one factor that may be perpetuating the population decline of the threatened New Zealand (NZ) sea lion (*Phocarctos hookeri*). The species has a severely restricted distribution, with 99% of breeding occurring on the remote NZ sub-Antarctic islands and amongst the lowest expected reproductive outputs compared to other otariids. Infectious disease, particularly septicaemia caused by the bacterium *Klebsiella pneumoniae* is known to be a major mediator of early pup mortality, but the role of infectious disease in impairment of reproductive success has not been investigated.

This thesis aimed to fill this knowledge gap by investigating three areas of concern. Firstly, the role of infectious disease in stillbirth of NZ sea lion pups was examined with a histopathological study of archived necropsy tissues. Secondly, the seroprevalence of adult and juvenile NZ sea lions to *Toxoplasma gondii*, a known cause of reproductive failure, at several locations was evaluated. Finally, a survival analysis was conducted to model the long term survival and reproductive success of pups that were treated with ivermectin as pups, to assess ongoing benefits of early hookworm burden removal.

In contrast to the mass mortalities seen with bacterial disease in NZ sea lion colonies, at least in the topics covered in this thesis, the role of infectious disease contributing to poor reproductive success is apparently minimal. No specific infectious agents were identified to have caused the death of the stillborn pups examined, however pneumonia was diagnosed in four animals. A low seroprevalence to *T. gondii* was found in mainland but not sub-Antarctic colonies, however those animals with strongly positive titres showed no clinical signs and had reproduced normally. Finally, although the survival analysis was limited by small sample size and very poor juvenile survival, it depicted promising trends for improved survival for those pups treated with ivermectin as pups. All studies have generated areas for future research and recommendations for further conservation management of this vulnerable species.
Acknowledgements

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This thesis has been completed despite the distraction of my office buddies over the years, but nonetheless thanks go to Baukje Lenting, Micah Jensen, Danielle Sijbranda, Karina Argandona, Serena Finlayson, Aditi Sriram and Rebecca Webster for their friendship accompanied by hours of entertainment, cat videos and coffee trips. Further, I have been lucky to have the moral support and friendship of Zoe Grange, Bridey White, Pauline Conayne, Carina Svensson and Deneka De Sousa. Finally I would like to thank my family for support and encouragement during my last four years in New Zealand. All of the people mentioned above have helped me reach the end of this thesis amongst three and a half years of challenging but fulfilling work during my wildlife veterinary residency including a major oil spill.

Many thanks to Dr Laryssa Howe for guiding me through the ELISA and western blot techniques for *T. gondii* and Kat Scarfe at NZVP for assistance with the latex agglutination test. Thank you also to Evelyn and Saritha in the histology lab and Mike and Craig in the post mortem room for help with processing stillborn pup tissues. This work could not have gone ahead without the hard work of the New Zealand sea lion teams, Department of Conservation workers and researchers working on sea
lions on the mainland and sub-Antarctic between 1998 and 2012 for sample collection and resighting records.

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