The impact of conservation translocations on vector-borne parasites

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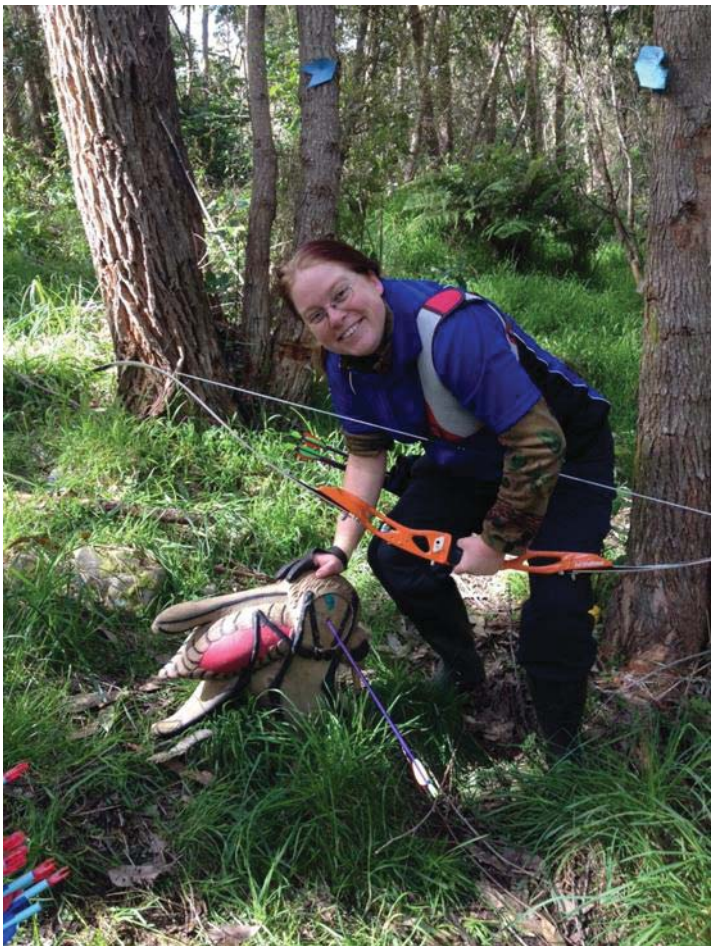
Abstract

Wildlife conservation in New Zealand relies on translocations of endangered species to safe sites. While knowledge of the biology and behaviour of translocated hosts has steadily increased, the role of parasites in wildlife translocations has been largely overlooked. Parasites can affect their host's survivorship during translocations by causing disease. However, failure to translocate or reintroduce a host specific parasite with its endangered host can contribute to the extinction of the parasite with unforeseen consequences for the future of the host or even the whole ecosystem. The main aims of this study were to establish baseline data on the impact of North Island saddleback translocations on their avian malaria (*Plasmodium* spp.) parasites as well as gaining further insight into potential vectors in New Zealand. The study was also intended to contribute to the development of recommendations for future parasite screening programmes for native passerine translocations. Saddlebacks and *Plasmodium* were chosen because of the detailed saddleback translocation history and its known relationship with the parasite.

As a result of this study, several *Plasmodium* lineages previously unrecorded in saddlebacks and New Zealand were identified, for example, the native Kokako01 and one lineage closest related to two lineages from the Americas. Nonetheless, the most frequent lineages found were the cosmopolitan *P. elongatum* GRW6 and LINN1, and *P. vaughani* SYAT05, common in birds introduced to New Zealand. This finding suggests that endemic parasites may have already become rare or extinct. In addition, *Plasmodium* DNA was detected in both native and introduced mosquitoes that may act as vectors. A qPCR assay was developed that was found to be a cost effective and rapid screening tool for the detection of *Plasmodium* in native birds suffering from acute infection, presenting with clinical symptoms, and in birds that were found dead. .

I conclude that future translocations should consider the movement of endemic parasites with their hosts. How this should happen is open for future studies. However, I urge managers to start considering this issue now as New Zealand has already recorded the extinction of one endemic parasite and many more may have already been lost without knowledge.

Acknowledgements



Having fun hunting mosquitoes in the New Zealand bush (picture by courtesy of Gillian Gordon)

Foremost, I have to thank my parents and family who enabled me to come to New Zealand and provided me with ongoing support. I am also very grateful to my wonderful supervisors, Isabel Castro, Laryssa Howe, Daniel Tompkins and Kevin Parker, for their patience and understanding. Without them I might have had many more difficulties and I owe them very much for their help in crossing the hard patches. They were always there when I needed them, to share new discoveries as well as tears, which has earned them my utmost respect and appreciation.

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I also would like to thank Tamsin Ward-Smith and the team of Cape Sanctuary (Cape Kidnappers, Hawkes Bay) for access to the sanctuary as well as taking me along for the saddleback translocation from Cuvier Island to the Cape. That was a very unique trip!

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I would like to thank the Whangarei City Council for permission to sample introduced birds in Mair Park in Whangarei.

This study would not have been possible without the help of many enthusiastic volunteers and colleagues, they are too many and I am in danger of forgetting one of you. So to all of you, thank you very much!!! I especially want to thank Bethany Jackson for assisting me with mosquito sampling on Tiritiri Matangi Island and Josie Galbraith for letting me join her for birds sampling in Auckland.

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Preface

This thesis is formatted in a series of distinct research manuscripts ready for publication. As a consequence, the individual chapters contain unavoidable repetition. This thesis is the original work of the author, unless otherwise stated in the references, methods and acknowledgements.

The field methods used in this study were the same as those used by Dr Isabel Castro and collaborators when studying the epidemiology of avian malaria in New Zealand passerines in 2007/2008.

The animal ethics protocol for this study was approved by the Animal Ethics Committee at Massey University, MUAEC Protocol 11/59. Birds from different offshore islands were sampled under the following Department of Conservation permits: NO-33680-FAU, TW-32756-FAU and ECBP-32634-RES. Birds were banded under institutional banding permit No. 2012/009.

This study would not have been possible without the generous funding by the Morris Animal Foundation, study grant ID number D13ZO-811: Do Translocations for Species Restoration Cause Pathogen Pollution?

I would like to advise the reader that this thesis started out as a study on wildlife translocations and their potential to cause pathogen pollution. During the work, and after receiving the first results, the emphasis shifted away from the potential impact of parasites on wildlife translocations towards the impact of wildlife translocations on native parasites, which can potentially cause extinction of rare parasites. This shift can be noted through the earlier chapters of this thesis, in particular as I carried out a review of the pathogen pollution literature and developed hypotheses and predictions that were directed towards explaining pathogen pollution. Please consider this when reading.

The raw data for this thesis can be found at the back of this document, in Appendix 6.

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With few exceptions, all the pictures in this thesis have been taken by the author, Ellen Schoener. Photographs from other sources have been acknowledged in the legends.

List of tables

List of abbreviations

°C	Temperature in degrees centigrade
µl	Microlitres
µm	Micrometres
µM	Micromoles
BLAST	Basic local alignment search tool
bp	Base pairs
CDC	Center for Disease Control
cm	Centimetres
CNS	Central nervous system
CO_2	Carbon dioxide
Cq value	Quantification cycle value
Ct values	PCR crossing points
DNA	Deoxyribonucleic acid
dNTP	2'-deoxynucleotide 5'-triphosphate
DoC	Department of Conservation
EDTA	Ethylenediaminetetraacetic acid
et al.	Et alia/and others
g	Grams
H&E	Haematoxylin and eosin stain
ha	Hectare
hr	Hour
HRM	High resolution melting
IUCN	International Union for the Conservation of Nature and Natural resources
IVABS	Institute of Veterinary, Animal and Biomedical Sciences (Massey University)
kDa	Kilodalton
mg	Milligrams
$MgCl_2$	Magnesium chloride
MHC	Major histocompatibility complex
min	Minute
MIR	Minimum infection rate
ml	Millilitres
mm	Millimetres
mM	Millimoles
MUAEC	Massey University Animal Ethics Committee

MYA	Million years
n	Number
ng	Nanograms
NI	North Island (of New Zealand)
NZ	New Zealand
PBS	Phosphate buffered saline
PCR	Polymerase chain reaction
qPCR	Quantitative PCR/real-time PCR
RNA	Ribonucleic acid
rRNA	Ribosomal ribonucleic acid
SDS	Sodium dodecyl sulphate
spp.	Plural of species
SSC	Species survival commission
T_m	Melting temperature