Avian Malaria (*Plasmodium* spp.) in the Auckland Region: Host-Parasite Associations, Capture Technique Bias, and Landscape Disease Dynamics

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

Master of Science in Conservation Biology

Massey University

Auckland, New Zealand

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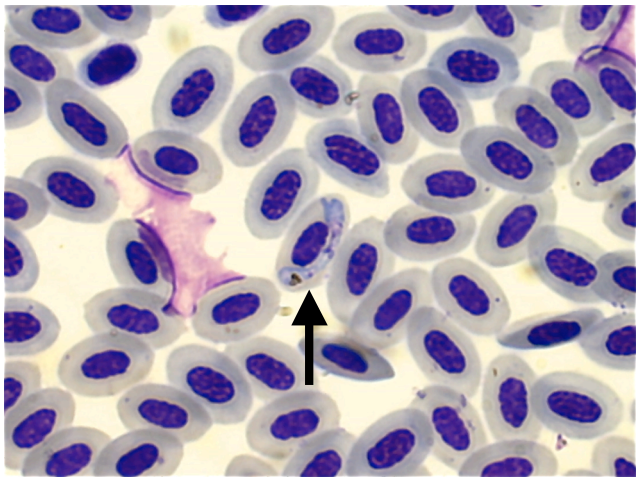
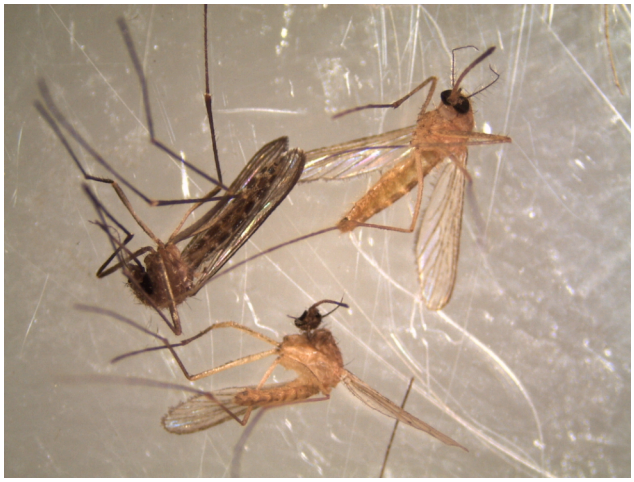
2011

Bellbird (*Anthornis melanura*)



Plasmodium (*Novyella*) sp. found in bellbirds



Two avian malaria vectors in New Zealand
Culex pervigilans (dark) and *Culex quinquefasciatus* (light)
Photographs by D.J. Gudex-Cross

ABSTRACT

Avian malaria parasites (*Plasmodium* spp.) are distributed throughout the world and affect a vast range of bird species. However many aspects of avian malaria in New Zealand, such as the extent of parasite diversity, distribution and prevalence in host populations, are currently unknown. Thus, the first aim of this study was to examine these parameters in native and exotic bird species of the Auckland Region, North Island. A total of 21 species were sampled at two sites: Tiritiri Matangi Island and Waharau Regional Park. Of these, five native (bellbird *Anthornis melanura*, tui *Prosthemadera novaeseelandiae*, New Zealand fantail *Rhipidura fuliginosa placabilis*, North Island tomtit *Petroica macrocephala toitoi* and silvereye *Zosterops lateralis*) and three exotic (myna *Acridotheres tristis*, blackbird *Turdus merula* and song thrush *T. philomelos*) species were infected. This is the first reported incidence of avian malaria in the New Zealand fantail, and only the second record in tui. The parasite morphospecies identified in this survey were *P.* (*Haemamoeba*) *relictum*, *P.* (*Huffia*) *elongatum*, *P.* (*Novyella*) *rouxi* and two *P.* (*Novyella*) spp. not yet formally taxonomically described, one of which appears to be specific to the endemic bellbird. Parasite prevalence within the two most heavily sampled species varied strikingly: bellbird prevalence was estimated at 41.5% (*N* = 51/123) in the Tiritiri Matangi population and silvereye prevalence at 9.2% (*N* = 22/240) within the Waharau population.

The other two objectives of this study addressed: 1) the potential bias that choice of capture technique may have in avian malaria surveys and 2) the effects of forest fragmentation on avian malaria and vector distributions. The first objective was investigated by comparing prevalence and parasitaemia in adult male bellbirds on Tiritiri

Matangi Island caught *via* two live-capture techniques: mist netting and supplementary feeder trapping. In this instance it was found that the choice of capture method did influence results: mist netting of bellbirds yielded significantly higher parasitaemia than feeder trapping. The second objective was investigated through a comparison of mosquito species abundance, composition, and avian malaria prevalence in silvereyes at forest edge *versus* interior sites in Waharau Regional Park. A total of five mosquito species, three native (*Aedes antipodeus*, *Culex asteliae* and *Cx. pervigilans*) and two exotic (*Ae. notoscriptus* and *Cx. quinquefasciatus*), were trapped in this study. Significantly more exotic mosquitoes were trapped at the forest edge, with almost complete absence in the interior. Furthermore, analysis of the individual species showed a significant edge-association for *Cx. quinquefasciatus*. Although significantly more native mosquitoes were trapped in the forest interior *versus* the edge, this was due to high *Ae. antipodeus* abundance in one interior site. Consequently, no edge- or interior-associations were found for the individual native species. Finally, avian malaria prevalence in silvereyes did not significantly differ between forest edge and interior.

The outcomes of this study included: a) additional baseline prevalence data for New Zealand; b) records of two new parasite-native bird associations; c) a demonstration that different live-capture techniques can bias estimates of parasitaemia; d) confirmation that forest edge habitats are more prone to exotic mosquito invasions in New Zealand; and e) determination that avian malaria prevalence in the silvereye does not differ between birds caught at forest edge and interior and is thus not closely correlated to mosquito distribution at these sites. A discussion of the future avenues of avian malaria research in New Zealand is provided at the end of this study.

ACKNOWLEDGEMENTS

First and foremost I'd like to thank my parents, Bev Gudex and Ron Cross, for all the love and support they put behind all my endeavours. I wouldn't be the person I am today without you guys, both literally and figuratively! Love ya.

Next a gracious bout of thanks to my advisors: Rosemary Barraclough, Jose Derraik and Dianne Brunton. Rosemary, thank you for your helpful advice and unwavering support throughout the course of my studies. Jose, thank you for your fieldwork help and introducing me to your two wonderful sons. Dianne, thank you for allowing me the opportunity to join the Ecology and Conservation Group at Massey University and all your statistics help.

A big 'thank you' to Tim Lovegrove for his gracious assistance with planning my stay at Waharau and support throughout my time in New Zealand. Also to Michael Anderson for helping me with fieldwork and thesis writing. Cheers, Doc. Speaking of fieldwork, this thesis wouldn't be half the book it is today without the help of all my great volunteers. So many thanks to Ash King and Jennifer Bruce for helping me on Tiritiri Matangi. Rémi Bigonneau and Cécile Houille, thanks for your help at Waharau – and thanks Rémi for extending your stay to help me polish off those cases of wine, er, for the sake of my project. Thanks to Karli Stevens (I'm still Scrabble Master!), Elizabeth Milne, and the friendly folks at Ecoquest for additional help at Waharau. Also, Ranger Mike! Thanks for those thrilling four-wheeler rides along the tracks of Waharau, and for your kindness and support during my stay in the park. Thanks to the Supporters of Tiritiri Matangi Island

and Rangers Dave and James for providing me with tips on where to catch birds on the island.

Finally, I'd like to thank all the friends and colleagues I've made at Massey and throughout the country – you've helped make my two years in New Zealand ones to define a lifetime by. So a tasty pint and cheers! to: Ashleigh Kirkwood, Idan Shapira and Dana Lischinsky, Sarah Wells, Jo Peace, Kevin Parker, Josie Galbraith, Luis Ortiz-Catedral, Marleen Baling, John Steemson, Jennifer Rickett, Anne-Sophie Boyer, Marta Guemes, Karen Stockin, David Raubenheimer, Weihong Ji, Lucy Morris, Jan Maether, Amanda Jennings, Emmanuelle Martinez-Smagghe, Manuela Barry, Brigitte Kreigenhofer, Andy Warneford, Mark Seabrook-Davison, Sarah Dwyer, Gabrielle Machovsky Capuska, Fidi Jordan, Michelle Roper, Jenny Laycock…and everyone else I've had the pleasure of meeting along the way. It has been an honour befriending all of you.

The Real Work

It may be that when we no longer know what to do

we have come to our real work,

and that when we no longer know which way to go

we have come to our real journey.

The mind that is not baffled is not employed.

The impeded stream is the one that sings.

-Wendell Berry

(The Collected Poems of Wendell Berry ©1987, North Point Press)

PERMITTING AND BIRD NOMENCLATURE

This research was approved by the Massey university Animal Ethics Committee (AEC/13, amended 01/09) and Department of Conservation (permit AK-20666-FAU). Bird banding was carried out under Department of Conservation permit No. 2008/33. Massey University (Masterate Scholarship) and the Auckland Regional Council provided funding for this study.

The scientific names of New Zealand birds used in this study follow the nomenclature of:

Gill, B.J., B.D. Bell, G.K. Chambers, D.G. Medway, R.L. Palma, R.P. Scofield, A.J.D. Tennyson and T.H. Worthy. 2010. Checklist of the birds of New Zealand, Norfolk, Macquarie Islands, and the Ross dependency, Antarctica. Fourth Edition. Te Papa Press, Wellington, New Zealand, in association with the Ornithological Society of NZ Inc.

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