An Australian Abroad: The secret life of the brushtail possum (*Trichosurus vulpecula*)

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Dedication

For Apple Monster

Abstract

The “superspreader” hypothesis relates disease transmission to social contacts and assumes transmission is driven by the frequency, type and distribution of contacts among infected and susceptible individuals. I investigated characteristics of brushtail possum *(Trichosurus vulpecula)* home ranges for six wild free-living subpopulations, (four grids were studied; all of them before possum depopulation and two of them after possum depopulation) constructing social networks relevant to bovine tuberculosis (TB) transmission before and after depopulation. I also experimentally infected possums with a novel strain of TB to monitor secondary case infections in relation to these contact and other factors, including population density and sex ratio.

Before depopulation home range estimates showed adult males had larger home ranges than female and younger possums. Home range overlap and area of overlap differed between subpopulations, and possum sex and age; with adult males having more and larger overlaps with other possums. Possums were fitted with proximity-logging collars and contacts registered between April and October, 2012. The number of connections an individual has with others and the probability of the distribution of contacts it has within the population, or node degree and betweenness, also known as the shortest distance between individuals, were associated with sex, with males having higher values for each. Males also contacted more possums than females. Post-depopulation results showed an influx of male possums, higher population density, and smaller home range sizes than before depopulation. Possums post-depopulation also lacked an apparent ‘routine’ in contact networks, interacting with other possums haphazardly. The greater level of contact among adult males, than before depopulation, and their effects

on recovering populations post-depopulation, was likely the cause of more TB infection in adults and males.

This thesis provides empirical evidence that adult male possums have home range and contact network characteristics that are likely to enhance their involvement in the transmission and persistence of TB, relative to female and younger possums. Observations of experimentally infected individuals showed that infected males survived longer than females and that, as a consequence, those males potentially acted as a “supershedding” subgroup. I therefore provide evidence that adult male possums are the most important drivers of TB transmission and persistence of infection in populations, and could be targeted for control measures.

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Thesis structure and format

This thesis is presented as a series of seven chapters. Encompassed by a general introduction and discussion, five research chapters have been prepared and are presented for future publication in peer reviewed journals.

Chapter one

General introduction and literature review introduces the concepts behind the research contained in this thesis by discussion and reviewing current literature of basic ecology of brushtail possums and disease ecology associated with the aspects of bovine tuberculosis.

Chapter two

Interacting determinants of brushtail possum (*Trichosurus vulpecula*) home range size and implication for possum population management will be submitted to Australian Journal of Ecology

Chapter three

Home range overlaps in the brushtail possum (*Trichosurus vulpecula*): investigating potential intrinsic and extrinsic determinants will be submitted to Australian Journal of Ecology

Chapter four

Construction of brushtail possum (*Trichosurus vulpecula*) contact networks to inform on bovine tuberculosis transmission between individuals, and its persistence in wild populations

Chapter five

Changes in population structure following depopulation; implications for TB transmission and persistence

Chapter six

Relating variation in tuberculosis (TB) transmission in brushtail possums (*Trichosurus vulpecula*) to potential drivers found at the environmental, population and individual level

Chapter seven

General discussion summarises the significant findings of this study. The relevance and implications are discussed and future research directions are suggested.

Chapter eight

Literature cited has been collated at the end of the thesis to reduce repetition. Literature is referred to in the format consistent with the format used for the journal Ecology.

Chapter nine

Appendix: Improving animal welfare standards while reducing disease exposure risk during euthanasia of trapped brushtail possums (*Trichosurus vulpecula*), C. Rouco, K.S. Richardson, D.M. Tompkins. Published Animal Welfare 2015, Vol 24; pg 235-239.

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