Predator-prey interactions through the lens of coevolution and ecological context

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Thesis submitted in fulfilment of the requirements for
the degree of Doctor of Philosophy

under the supervision of Daniel Ramp and Arian Wallach

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Certificate of Original Authorship

I, Eamonn Ivor Fraser Wooster, declare that this thesis is submitted in fulfilment of the requirements of the award of Doctor of Philosophy, in the School of Life Sciences, Science at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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List of Papers and Statement of Author Contribution

This thesis is a compilation of chapters and 5 published/publishable manuscripts. Each paper is formatted for their destination journals, except for referencing styles which feature as a single list at the end of the thesis.

Chapter 2 – In Preparation

Wooster, E.I.F.; Ramp, D.; Lundgren E.J.; Bonsen, G.T.; O'Neill A.J.; Wallach, A.D. Australian small mammals are fox savvy. In preparation

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Trophic structures of a common mid-west North American ecosystems (i.e., Yellowstone National Park) visualised through two frameworks; a) the landscape of fear, predators inspire fear in small prey and mesopredator species, both directly killing them and altering their behaviour. b) A conceptual model describing the landscape of knowledge, driven by cognitive trophic cascades. Brown bears tolerate fox presence while they hunt, serving to protect foxes from wolf predation (1 - Harris et al. (2008), red foxes, when cohabitating with apex predators develop detailed knowledge of their activity patterns and avoid them (2 - Wooster et al. (2021), elk and other large herbivores increase their vigilance when wolves are present, allowing them to avoid predation (3 - Laundré et al. (2001), coyotes and badgers cooperate, instead of competing to hunt small mammals (4 - Minta et al. (1992). Blue lines represent cognitive trophic cascades. Red lines represent predation

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Thesis Abstract

The red fox (*Vulpes vulpes*) is one of the world's most widely distributed mesopredators. They influence ecosystems primarily through the predation of prey species, driving cascading effects on plant and animal communities. In modern times, red foxes have been introduced to new locales, forming part of native and non-native conglomerates. The resulting amalgamation of native and non-native predator communities have been described as producing novel trophic cascades. While some acknowledge the important rewiring of lost functions due to extinction, there remains widespread concern about the negative role introduced species might play as they lack coevolved traits and relationships with native prey. To that end, the introduction of novel predators, like foxes, has been suggested to be a leading cause of decline and extinction of small mammal prey, especially in Australia. Rather than detailed consideration of the niche that introduced predators fit into, and their functional similarities with lost species, foxes and other introduced mesopredators like cats (*Felis catus*) are maligned by conservation values that promote native prey and the prevention of extinction. Negative connotations around alien and invasive species frequently override sound ecological assessment and cloud the establishment of evidence-based environmental policy.

Rather than absorbing narratives of harm, what happens when we suspend our assumptions that introduced species are ecologically damaging? Is it possible that the role of introduced mesopredators in driving extinctions is overstated? Is it also possible that long histories of coevolution are less important than the contextual and functional

roles predators play in trophic cascades? Asking these questions is vital if we are to find transparent and peaceful ecological solutions to improve nature conservation and prevent extinction and harm. Within this thesis, I explore these questions with a desire to understand how the red fox shapes the behaviour and ecology of their prey and how this compares to the foxes native range. Further, I explore how the fox fits into Australian novel ecosystems but exploring their interactions with dingoes and how these are shaped by human hunting.

Red foxes, like any other predator, play important ecological roles, however, assumptions of their harm, have prevented us from fully exploring their ecologies within novel ecosystems. By dropping assumptions that foxes are inherently harmful, I show that the foxes biotic nativeness has very little to do with their ecological interactions, the foxes ecology and behaviour may, instead be better predicted by ecological context.