Human-mediated landscapes of fear shape trophic cascades in shared desert ecosystems of the Middle East: elucidating the ecological roles of the Arabian wolf (*Canis lupus arabs*)

by Gavin Bonsen

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, Gavin Bonsen, declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Life Sciences 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.

This research is supported by an Australian Government Research Training Program.

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I hope this thesis can play a part, in one way or another, in transitioning towards a more peaceful co-existence between human and non-human animals.

List of Papers and Statement of Author Contribution

This thesis is a compilation of an introductory chapter and the following four manuscripts currently either published or in preparation for publication. Referencing style throughout this thesis is based on the journal *Biological Conservation.*

Chapter 2. Navigating a geopolitically complex landscape: the Arabian wolf's complicated plight.
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Chapter 3. Tolerance of wolves shapes desert canid communities in the Middle East.
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Abstract

Grey wolf (*Canis lupus*) populations are increasing globally, thanks to a general rise in human acceptance. However, the smallest subspecies, the Arabian wolf (*Canis lupus arabs*), remains endangered across its wide range in the Middle East. Human land-use varies throughout its range, as do attitudes towards wolves, which range from acceptance to complete intolerance. Likely to have played a large part in the increase in acceptance of wolves in other regions is the knowledge of the important ecological roles they play as apex predators. Presence of wolves has been linked to profound, cascading effects, which have been claimed to benefit ecosystems across multiple trophic levels. This has consistently been demonstrated in temperate regions, where ecosystems are productive, but doubt has been cast over whether Arabian wolves play similar roles in the arid to hyper-arid ecosystems they inhabit. In this thesis, I begin by exploring the mechanisms and approaches that have previously gone into global wolf conservation efforts, assisting in their recovery, and then contextualise this within the geopolitical diversity of the Middle East. Realising that relatively little is known about Arabian wolves, from their ecology to their taxonomic status and distribution, I set out to discover whether they have the capacity to influence ecosystems in similar ways to their temperate counterparts. I conducted ecological studies in the deserts of Israel and Jordan to identify the ways in which Arabian wolves shape ecosystem structure and function through their interactions with other species, and how these are mediated by human-wolf relationships. Using non-invasive survey techniques (camera-traps and passive tracking surveys), I found that wolf occupancy and density are largely related to human land-use, where wolves use areas where they are accepted but avoid areas where they are not tolerated. This then has cascading effects through the ecosystem, influencing canid communities, landscapes of fear for mesopredators and prey, and behavioural responses of predators and prey. This thesis unearths the importance of Arabian wolves in desert ecosystems by showing their role in influencing spatial distributions and behaviours of species in lower trophic levels. The last half-century has already witnessed the loss of two other large predators throughout the region, and this functional role would disappear if the Arabian wolf was to follow suit. Through improved conservation efforts and working towards a peaceful co-existence between people and Arabian wolves, this unique and iconic subspecies of wolf can persist, along with its important ecological role.