

University of Alberta

Predicting conservation status of North American avian and mammalian scavengers: Implications of geography, life history, behaviour and human disturbance

by

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Master of Science

in

Wildlife Ecology and Management

Department of Renewable Resources

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Dedication

I would like to dedicate this thesis to those who were with me when I started this journey and were more than willing to provide support and encouragement, but who are no longer here to celebrate its conclusion. Grandpa Ives, Grandma King, Dallas Gendall and Suzanne Abele – missed always, never forgotten.

PREVIEW

Abstract

Conservation risk is spatially and taxonomically variable, affected by both biological (intrinsic) and environmental (extrinsic) factors. To better understand this variability, I examined how intrinsic and extrinsic factors influenced sub-national patterns of conservation risk in North America for 43 avian and 37 mammalian scavengers. Conservation risk for avian species was most influenced by life history and behavioral traits, while conservation risk for mammalian species was determined more by range size, body mass and human disturbance. Correlations between conservation statuses of scavengers suggested that co-extirpations might be due to losses of behavioral interactions among highly interactive scavengers. These losses may contribute to observed patterns in conservation risk. The most interactive species were ravens, black and grizzly bears, gray wolves and river otters. These findings emphasize the importance of behavioural interactions among species on conservation status. I suggest that dependencies be examined prior to reintroduction efforts, with multi-species reintroductions considered.

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PREVIEW

1 Introduction

In the context of a scientific field, conservation biology is still a relative newcomer. It is often referred to as a “crisis discipline” (Soulé 1985) or a “discipline with a deadline” (Wilson 2000), due to recent dramatic declines in biodiversity across the globe (Pimm *et al.* 1995; Regan *et al.* 2001). The question remains, how should conservation actions be prioritized to maximize their impact. Given that time and resources are limited, it is imperative that we make informed and effective management choices. Which species are most threatened? Are there patterns and/or generalizations of threatened species? In this thesis I will examine how intrinsic and extrinsic factors affect the conservation status of avian and mammalian species in the scavenging guild throughout North America, north of Mexico. In the following sections, I will describe each of the major factors affecting the conservation status of these vertebrate species, my hypotheses regarding patterns in the conservation status of scavengers, the significance of this work in the conservation field and my specific study objectives.

1.1 STUDY SCOPE AND SYSTEM

1.1.1 *Geographic Scale*

To date, several studies have examined factors influencing the extinction risk of species, most commonly on a global scale (Bennett and Owens 1997; Purvis *et al.* 2000; Long *et al.* 2007; Cardillo *et al.* 2008; Davidson *et al.* 2009; Lee & Jetz 2010). Most often these studies have focused on a single taxonomic group, or

charismatic, well described family such as mammals, with a particular focus on carnivores and primates (Purvis *et al.* 2000; Cardillo *et al.* 2008; Fritz *et al.* 2009). Although global analyses often provide the largest datasets and sample sizes, such approaches can mask regional variation in threats and species traits as a result of heterogeneity among both taxonomic groups and geographical regions (Fisher & Owens 2004; Collen *et al.* 2006; Cardillo *et al.* 2008). It is common for species risk and vulnerability to vary on a local scale from population to population. Accounting for this natural heterogeneity by limiting the study to a smaller area provides greater insight into the patterns and causes of species risk at the scale of which policy and management is directed. I therefore apply a North American focus to narrow the scope of the analysis of sub-national (state and province) patterns in species risk. Doing so provides a connection between large, multi-species global studies and targeted local studies (Collen *et al.* 2006), facilitating generalized results while accounting for regional variation in conservation status. By analyzing conservation status patterns at more intermediate spatial scales, more insight is gained on how local, extrinsic factors interact with intrinsic factors such as species traits to affect variations in conservation status. Such scales are therefore more practical and useful than global based studies for prioritization of conservation actions.

1.1.2 Taxonomic Focus

Previous studies on extinction risk have typically focused on taxonomic groups, rather than functional groups. In many cases, the species within these taxonomic

groups perform unrelated ecological roles within a community, and as a result the specific functional relationships in the species assemblages remain unaccounted for when examining patterns in their risk. In this thesis, I instead examine patterns in conservation status in a guild of diverse, but ecologically connected species. A guild is defined as a group of species that are characterized by a similar exploitation of the same class of environmental resources (Root 1967). Species guilds are the “building blocks” of communities (Hawkins and MacMahon 1989) and recognizing this structure can be particularly useful in comparative studies of species assemblages. In North America, species that are known to scavenge carrion represent a highly important, but critically under-examined guild with high diversity in ecological strategies, life history and behaviour traits and responses to anthropogenic threats.

1.1.3 Scavenger Behaviour

There is a continuing negative perception associated with scavenging behaviour, with few studies examining the assemblages of terrestrial vertebrate scavengers and their behavioural interactions (DeVault *et al.* 2003). A major reason for this gap in knowledge is our natural aversion to decomposing matter. Decomposing substances generally repulse humans – this material, however, is often the centerpiece of scavenging. Even today, species field guides and ecology texts will often omit any reference to scavenging behaviour in animals that we typically view as “noble”, despite evidence that the species may, at times, use carrion (Tømmeraas 1989). Scavenging behaviour is also often viewed as a behavioural

“curiosity” rather than a critical ecological process (Wilton 1986). This is especially true in regions such as North America where we do not see specialized scavenging guilds and very few obligate scavengers – species that rely on carrion for survival. Although the term scavenger is often applied to only those species that are obligate scavengers (e.g. vultures), the distinction between predatory and scavenging animals is not very useful. Most predatory carnivores will scavenge food whenever they have the opportunity (opportunistic, facultative scavenging) - there is little advantage in passing up a free meal, should the opportunity arise (DeVault *et al.* 2003) and at times there can be little advantage in killing prey if high quality meat can be obtained through scavenging (Houston 1979). Of literature on scavenging assemblages, most has been focused on the avian group, as birds are best designed for scavenging, with soaring abilities and keen eyesight, and in some cases an excellent sense of smell. In particular, African ecosystems have received the most attention, as both highly specialized scavenging guilds and obligate scavengers are common (Houston 1979; Braack 1987; Gasaway *et al.* 1991; Dudley 1996; Cooper *et al.* 1999).

Although scavenger assemblages are typically characterized by “weak links” between trophic levels, it is becoming clear that these linkages are essential for maintaining the stability and persistence of ecosystems – missing or critically declining species may have severe repercussions across trophic levels (McCann 1998; Neutel 2002). As carrion resources are spatially and temporally dynamic in their availability to scavengers, the intensity and nature of species interactions

among different trophic levels varies in space and time (DeVault 2003). For example, common ravens (*Corvus corax*) are known to commonly associate with gray wolf (*Canis lupus*) packs as a strategy to locate fresh carrion (Harrington 1978; Stahler *et al.* 2002). These strong linkages or interactions may be important for the maintenance of certain species in the community, with the loss of one species potentially affecting the other, in what has been referred to as co-extirpation (Ebenman & Jonsson 2005). In some American states, common ravens and wolves have both been considered extirpated – a connection between the loss of one species and subsequent extirpation of another may become evident once other factors are accounted for.

The scavenging guild in North America includes a large array of mammalian and avian species with considerable diversity in ecology, life history and tolerance of anthropogenic impacts. As a result, this group presents a unique opportunity to investigate the influence of biological (intrinsic) and landscape (extrinsic) factors on the conservation status of a guild of species at scales that acknowledge landscape heterogeneity within the range of a species. Specifically, I will examine sub-national patterns in conservation status for 13 taxonomic families representing 42 mammal and 46 bird species in North America. For the purpose of this study, I defined a scavenger as a vertebrate species that is known to be at least partially carnivorous in its feeding habits and is part of ecologically relevant behavioural interactions with other scavenger species in relation to carrion resources. As many of these species are considered charismatic, they are

relatively well known and well described in the literature, allowing for extensive querying of information on natural history, ecology, behavioural interactions and potential responses to anthropogenic threats.

1.2 PREDICTORS AND COMPETING HYPOTHESES OF CONSERVATION STATUS

Intrinsic factors such as life history traits (e.g. body size, gestation period and age of sexual maturity), ecological traits (e.g. range size and distribution) and behaviour traits (e.g. sociality, circadian and annual activity patterns and seasonal migrations) may predispose a species to decline (Pimm 1988, Gaston & Blackburn 1995). It is unlikely, however, that these factors affect species conservation status independently, potentially interacting with each other in an additive manner. These intrinsic interactions are further affected by extrinsic environmental factors in the form of anthropogenic threats (Gaston & Blackburn 1995). Environmental factors are considered as levels of exposure to human impacts (threats) faced by species within their range. I will use these four broad explanatory factors (1. Life history traits; 2. Ecological traits; 3. Behavioural traits; and 4. Anthropogenic effects) as representatives of competing, but not necessarily mutually exclusive hypotheses for predicting the conservation status of species within the vertebrate scavenging guild of North America. I will subsequently examine whether behavioural interactions between species (a fifth co-extirpation hypothesis) help explain current patterns in conservation statuses of scavenger species.

The conservation status for each species in this thesis is recorded at a sub-national scale (provinces and states) using the online NatureServe database, an international network of biological (natural heritage) inventories operating in the United States and Canada (Stein 2002). NatureServe is internationally recognized and widely used for prioritizing species conservation (O'Grady *et al.* 2004).

1.3 SIGNIFICANCE

Globally, the human population continues to increase, and with it, so too does the level of threat faced by many species. As a result, now more than ever, it is critical that we identify the underlying mechanisms behind species' current conservation statuses and associated risk, and make use of both intrinsic and extrinsic factors to predict which species may decline in the future in the face of escalating human pressure (Cardillo *et al.* 2004, 2008). Understanding the biological and anthropogenic mechanisms that result in different conservation statuses and utilizing this knowledge to reliably predict which species may be become threatened in the future allows biologists and managers to be proactive in their conservation decisions and the allocation of limited resources.

1.4 STUDY OBJECTIVES

The first objective of this thesis is to determine the strength of relationships (correlations) between the conservation statuses of different species within the same scavenging guild for five major biomes of North America, north of Mexico. I examine whether behavioral interactions help explain significant positive

relationships between scavengers, suggesting the possible presence of co-risk and co-extirpation processes, where the loss of one species leads to increased risk for the other species. This objective is addressed in Chapter 2.

My second objective is to examine how ecological, life history and behavioral traits as well as anthropogenic impacts individually and interactively influence the sub-national (state and province) conservation status of species across North America, north of Mexico for the scavenging guild. This objective is addressed in Chapter 3.

By examining the relationships between species, different life history traits and the environment, I hope to better understand the degree to which variation in species' conservation status is related to extrinsic threats versus differences in intrinsic traits and behavioral interactions. This will help determine whether it is possible to predict which species are most at risk of decline in the future in the face of increasing anthropogenic threats associated with human population growth and land use changes.

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