8-10-2021

Coyote- A Wily, New Emblem for the Anthropocene? Why One of the Most Reviled Predators in North America Could Change Conservation Forever.

Kimberly Myers
Georgia State University

Coyote- A Wily, New Emblem for the Anthropocene?

Why One of the Most Reviled Predators in America Could Change Conservation Forever.

by

Kimberly Myers

Under the Direction of Frank L'Engle Williams, PhD

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Masters of Arts

in the College of Arts and Sciences

Georgia State University

2021

ABSTRACT

Human populations have grown dramatically in the last century. Animal species have responded in different ways, some adapting and exploiting human urban centers, like squirrels and raccoons. While other larger mammals, and predators specifically, are often extirpated. Since the 1970's it is estimated the earth has lost 58% of wild vertebrate life, while humans and domesticates make up 96 % of biomass. In contrast, coyotes have thrived despite being targeted by federal wildlife agencies as a pest species, and this is why they are currently being studied by an array of scientists such as biologists, anthropologists, and ethologists. A growing body of research indicates that current lethal removal methods of predators, especially coyotes, is less effective than non-lethal interventions. This thesis will interpret several evolutionary, historic, and anthropogenic factors that have led to the current "coyote situation" and how future wildlife management might be improved for both people and wildlife.

INDEX WORDS: Canids, *Canis latrans*, *Canis lupus*, coyote

Coyote- A Wily, New Emblem for the Anthropocene?

Why One of the Most Reviled Predators in North America Could Change Conservation Forever.

by

Kimberly Myers

Committee Chair: Frank Williams

Committee: Jennifer Patico

Bethany Turner

Electronic Version Approved:

Office of Graduate Services

College of Arts and Sciences

Georgia State University

August 2021

DEDICATION

I dedicate this thesis to my grandfather, Gary Mills, who was just one of the hundreds of thousands of Americans, and millions more world-wide, who lost their lives during the Corona virus pandemic in 2020.

ACKNOWLEDGEMENTS

I would like to thank my graduate advisor and mentor Frank L'Engle Williams for all of his support and unfailing encouragement during my time at Georgia State University. He never failed to encourage me to pursue my own research interests. It has truly been a pleasure to be mentored by him. I would also like to thank my other committee members, Dr. Jennifer Patico and Dr. Bethany Turner, for their time, feedback, and efforts to improve my graduate thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

BACKGROUND

Once found most commonly in the Western United States, since the early 1900's coyote (*Canis latrans*) populations in the U.S have rapidly increased. This population rebound and expansion immediately followed the widespread extirpations of native North American predator species like wolves (*Canis lupus*) and mountain lions (*Puma concolor*) in the early twentieth century. The coyote has since successfully colonized every state except Hawaii (Hody and Kays 2018; Hinton et al., 2019). They can now be found in every major urban center in Canada and North America, and in cities such as Atlanta, L.A, Chicago, and New York. Today, the coyote even seems well poised to colonize South America from populations in Central America (Flores, 2019; Gerht; 2006; Monroy et al., 2020).

No other North American predator has rebounded so quickly or increased their ranges in this way after the federally funded carnivore extermination efforts that occurred in the early and mid-1900's, and in many ways, are still going on today (Bekoff, 1995; Flores, 2016). For over a century the U.S federal government has been using generally the same lethal measurements to manage millions of wild animals like prairie dogs, wolves, coyotes, and beavers (Shivik, 2015; USDA APHIS, 1996-2020). In 2019 Wildlife Services, a branch of the federal government that manages native and invasive wildlife, removed some 61,000 coyotes at considerable expense to taxpayers, all having little to no effect in slowing coyote population expansion or increasing game animal numbers, which are controlled by forage growth and climate conditions. Despite a pandemic, in 2020, Wildlife Services removed even more coyotes, 62,700, than it did in 2019.

However, the rationale, ethics, and efficacy of these randomly implemented lethal control methods have been continuously disputed by biologists for almost a century now (Frank, 1924;

Leopold, 1934, 1944; Cain et al., 1971; Gese, 2005; ASM, 2012; Peterson and Nelson 2016; Artelle et al., 2018; Treves et al., 2019). A growing body of research indicates that random lethal control of predators and native species like the prairie dog, and perhaps most especially the coyote, are not only ethically questionable, but more expensive and less effective in ameliorating conflicts between people and wildlife than non-lethal methods (Nelson et al., 2011; Colman et al., 2014; Wielgus, 2014; Wallach et al., 2010, 2015; McManus et al., 2015; Shivik, 2015; Chapron and Treves 2016; Treves et al., 2016; Mowry and Wilson 2019). Additionally, more ecologists and biologists are calling for not only tolerating animals like coyotes but acknowledging the important ecological services they can provide by controlling populations of whitetail deer, feral cats, native mesopredators, rodents, and ticks (Gehrt, 2012; Ripple et al., 2014; Mowry and Wilson 2019; Kay, 2020).

The short amount of time in which the current "coyote situation" has unfolded in N. America represents a unique anthrozoological opportunity. Understanding how and why the man-made "coyote situation" has happened may aid ecologists and biologists in mounting practical responses to ecological degradation and speed its restoration. The looming specter of human caused climate change and an unfolding sixth mass extinction also highlight the need to overcome persistent ideological resistance to ecological restoration efforts such as rewilding (intentionally reintroducing) native species. While they are not endangered or likely ever will be, perhaps no other animal better illustrates the need for the reform of current wildlife management practices than the coyote. The story of its mismanagement by state and federal governments beholden to colonialist Utilitarian values may also show future conservationist practitioners how best to dismantle these counterproductive paradigms in time to fight climate and biodiversity loss simultaneously.

The narrative of this anthrozoological thesis will therefore be broad in scope, briefly exploring the evolution of the coyote, several indigenous peoples' Coyote myths, and some of the historical account of America's tandem efforts to destroy and conserve native wildlife. While this might be a story very much about coyotes and their biology, it is ultimately about human beings and why they persecute some animals but not others. Because anthropology is itself a discipline which has made a tradition of interrogating its own colonialist history, the perspectives of cultural and biological anthropology may be particularly useful along the way in crafting this investigation. To guide the overall inquiry of the thesis several research questions which relate to the past and present management of *C. latrans* through an anthrozoological lens will be addressed:

1. **Why is the coyote so much more successful and widespread in anthropogenic settings than any other endemic mammal predator today?**
2. **Are current lethal control methods used by state and federal agencies against coyotes effective in controlling their numbers and in keeping with the principles laid out by the North American Conservation Model?**
3. **Could human tolerant mesopredators like the coyote improve biodiversity in an increasingly anthropogenic world where larger predators are rare or unable to exist?**

Having our course set in that direction, we will address our first question- why the story of this one, seemingly indefatigable animal has had such a different outcome than all its native contemporaries in just over a century. To explore that question this investigation must begin by looking much farther back than that sliver of time.

CHAPTER 1

A Brief Recounting of 40 Million Years of *Canis latrans* Natural history

In the long history of humankind (and animal kind, too) those who learned to collaborate and improvise most effectively have prevailed.

— Charles Darwin

To answer our first question, why the coyote is able to thrive despite human persecution, this thesis will begin in keeping with what Pat Shipman has called the “White Rabbit Principle,” which generally proscribes that when one is undertaking the telling of a long and complicated story it is often wise to begin from what you understand to be the beginning and go on from there, stopping when reaching the end of what one knows (Shipman, 2015). In that vein, many important clues about what makes *C. latrans* so well suited to exploit human dominated landscapes may be found in the course of the species’ evolution as a middle weight carnivore that has always had to look over its shoulder in a landscape lousy with fiercer predators.

The earliest ancestors of *Canis latrans*, and all canids, are represented by three subfamilies, the Hesperocyoninae, the Borophaginae, and the only subfamily still living, the Caninae, to which all extant canines belong (Miklosi, 2015). The basal member of all three subfamilies were the small, civet-like Hesperocyoninae (40–15 Mya), and their relatives, the Borophaginae (34–2 Mya) which thrived throughout N. America during the middle and late Cenozoic (Wang and Tedford, 1996). The Hesperocyoninae, or "western dogs," were small animals the size of a fox and were named because of their canid-like inner ear structures. These

small omnivores were successful, and the group is well represented in fossil records from Mid Eocene Texas (Wang and Tedford, 2008). The second subfamily of early canids, the borophagines, or "bone-crushing dogs," are thought to have descended from the small *Hesperocyon*. The Borophaginae quickly diversified from the earliest of their line, the small and omnivorous *Archaeocyon*, into larger, entirely carnivorous, bone consuming specialists. The largest was *Epicyon heydeni* (more than a dog), the biggest canids to ever live, some of which were the size of bears (Wang and Tedford, 1994). These large forms may have evolved to scavenge megafauna carcasses and filled a hyena-like niche. The bone-crushers would have a long reign, until finally going extinct ~ 2 Mya (Wang and Tedford 2008).

At some point during the late Eocene (40-33.9 Mya) the story of N. American canid lineages diversified when the third subgroup, the Caninae, began to appear. Several species have been suggested as the earliest, such as *Prohesperocyon wilsoni* (36.6 Mya), whose fossils are found in what is now southwestern Texas (Wang, 1994; Wang and Tedford 2008). *Prohesperocyon* had a more obvious combination of features that mark it as a canine, including the loss of the third maxillary molars and the evolution of carnassial teeth. In canids the carnassial teeth would evolve via the modification of the 4th maxillary premolars and 1st mandibular molars, so they eventually met in a scissor-like fashion, indicating a trend toward hyper-carnivory and a flesh shearing bite. These animals also possessed the enlarged auditory bulla typical of all canids (Wang and Tedford 2008). Post-skeletally, it is thought that *Prohesperocyon* had longer limbs than its ancestors (a trend we will see again and again in the progression of canids), and toes more fitting of a runner, that were parallel and closely held together, rather than splayed like bears. These traits have become diagnostic markers of the canids that came after *Prohesperocyon* and the genus *Canis* in particular.

Table 1.1 Diagnostic Traits of the Canids

1. An enlarged auditory bulla (the hollow bony structure protecting the delicate parts of the ear) that is divided by a partial septum along the suture between the entotympanic and ectotympanic bones (Wang and Tedford 2008)
2. A relatively unreduced dental formula of 3142/3143 when compared to other carnivores (Wang and Tedford 2008).
3. An enlarged canine tooth, for which the genus is named (Wang and Tedford 2008).
4. Carnassial teeth, also seen in other carnivores, via the modification of the 4^{th} maxillary premolar and 1^{st} mandibular molars for a flesh shearing bite (Mech, 2006).
5. A humerus without an entepicondylar foramen (Munthe, 1998).
6. A 1st metatarsal that is reduced to a proximal rudiment (Munthe, 1998).

Eventually, by ~10 Mya, *Eucyon davisi,* a small coyote-like canid evolves, in what is now Arizona, and was likely a progenitor to many later canid forms (Tedford et al., 2009). The Southwest regions of North America produced the genesis of canids, but many of the modern species, like wolves and jackals, have roots in the Old World, and evolved only after crossing into Eurasia, Europe, and Africa (Crusafont-Pairó, 1950), and that makes the next part of the coyote's lineage difficult to track. Sometime around 7- 8 Mya *Eucyon, Vulpes* and *Nyctereutes,* (the later are the progenitors of foxes and racoon dogs*)* emigrated to Eurasia from N. America through Beringia. As part of these immigrations some propose that *Eucyon davisi* could have evolved into the canid ancestors of wolves, dogs, jackals, and dingoes in Eurasia, then some groups, like gray wolves, crossed back over and recolonized the Americas (Nowak, 1978; Wang and Tedford 2008; Tedford et al., 2009).

We now move forward to 5 Mya, to a windswept and arid grassland in Pliocene Texas, and observe camels, giant ground sloths, and another very coyote-like member of the genus, *Canis lepophagus*, "the rabbit-eater," which may have sprung from *Eucyon davisi*. The rabbit-eaters were roughly the same size as modern coyotes, but had 10 percent shorter limbs, indicating a less cursorial lifestyle which differed from the later trend of increased limb length in modern canids (Wang and Tedford 2008; p. 188; Tedford et al., 2009; p. 129). Johnston and Nowak describe specimens as having a more gracile skull and smaller sagittal crests (indicating less bite force) than modern C. *latrans*, painting an altogether more delicate and shorter version of today's coyote. Both thought the rabbit-eaters were likely to be somehow ancestral to modern coyotes (Johnston 1938; p. 385; Nowak 1978; p. 241).

A little over 3 Mya, a larger, more robust, and even longer legged canid trots onto the Texas scene, *Canis edwardii* (Edward's wolf), living in the same localities as *C. lepophagus* and overlapping with them for several million years (Tedford 2009; p. 129). There is some evidence of a linear progression in N. America from *E. davisi* to *C. lepophagus* to *C. edwardii* to modern *C. latrans* which is finally first seen in southwestern regions around 1 Mya, where it is sympatric with *edwardii* until as recently as ~300 Kya (Wang and Tedford 2008; p. 58). Reflecting a large Pleistocene habitat range, other notable early *C. latrans* fossils that fall within the size ranges of the modern coyote date to 0.74–0.85 Mya from Hamilton Cave, West Virginia, and 0.73 Mya from Irvington, California (Tedford, 2009). That same long linear progression of *Eucyon* descendants also potentially led to gray wolves in Eurasia, as Tedford and Wang point out early *C. lepophagus* fossils have synapomorphies of both coyotes and wolves (Wang and Tedford 2008; p. 58).

A better phylogeny is complicated by differences in expert opinion, as some of the most respected canid evolutionary specialists disagree about which specie(s) of canid left the Americas for Eurasia to become wolves, and which stayed put (or left and returned) to become coyotes in the American Southwest (Nowak, 1978; Wang and Tedford 2008; Tedford, 2009; Perri et al., 2021). Regardless of which canid species left by way of the Beringian corridor and evolved into wolves, what is clear is that those were very successful radiations in Eurasia and Europe, culminating in what has been called the "*wolf explosion*" or "*wolf event*" of the late Pleistocene (~ 2 Mya), when wolf-like canids start appearing in fossil records from Italy to China (Wang and Tedford 2008; p. 148; Jiangzuo, 2018). Tedford suggested that a wolf from China, *Canis armbrusteri,* may have been one of the original species to return to the Americas and led to various *Canis* lines, including dire wolves (*Anoncyon dirus*) (Wang and Tedford 2008; p.148). However, that theory has been thrown into doubt by dire wolf genetics published in 2021 which indicate that they were highly divergent and reproductively isolated from wolves and coyotes for over five million years (Perri et al., 2021).

By at least half a million years ago the gray wolf had developed and split into several subspecies and begun spreading throughout Europe and northern Asia (Nowak, 1992). Possibly stemming from *edwardii, armbrusteri* or another related Beringian wolf population, gray wolves appear 500 K later in N. America then the coyote (Perri et al., 2021). One of the oldest potential N. American *C. lupus* fossils, 810,000 years old, comes from Cripple Creek in Fairbanks Alaska, and though the picture is not entirely clear, the site indicates that by at least 500 K ago some large, very wolfish canids had begun recolonizing their American homeland in earnest by that time (Tedford et al., 2009).

Table 2.1 Evolution of the Canids

Species	Geological Age	Reference
Hesperonae	40 - 15 Mya	Wang and Tedford 2008
Boroghaginae	34 - 2 Mya	Wang and Tedford 2008
Caninae	40 - 33.9 Mya	Tedford et al., 2009
Eucyon davisi	10 - 7 Mya	Tedford et al., 2009
Canis lepophagus	5 - 1.8 Mya	Nowak, 1979
Canis edwardii	2.3 Mya - 300 Kya	Nowak, 1979; Wang and Tedford 2008
Canis armbrusteri	1.9 Mya - 250 Kya	Mech, 2006
Canis latrans	1 Mya - present	Mech, 2006; Tedford et al., 2009
Canis/ Anonycyon dirus	~ 200 - 9 Kya	Perri et al., 2021
Canis lupus	~ 500 Kya- present	Wang and Tedford, 2009
Canis lupus domesticus	~ 40-23 Kya- present	Perri et al., 2021

The arrival of a larger canid competitor would play an extreme hand in shaping coyote evolution and behavioral plasticity in response to trophic pressure from other predators (Meachen and Samuels 2012; Meachen et al., 2014). The climatically turbulent time frame canids radiate into so many forms and migrate also represents a transition from the Lower to the Middle Paleolithic and includes major evolutionary changes and migrations in the history of our own species, *Homo sapiens sapiens* (Pierotti and Fog 2017). Having covered some 40 million years of *C. latrans* evolution we find ourselves at the end of the Pleistocene, near the next stage of rapid coyote evolution, and quickly approaching the first arrivals of human beings in the New World at least 18-16 Kya (Denevan, 1992). The Holocene is just a bit further on the horizon from that (~12 Kya-present).

The final products of the canid radiations are represented today by a successful group of animals that are easily identified by humans across the world, by their pointed ears, long faces, characteristically robust canine teeth, and a generally ubiquitous body design shaped for cursorial pursuit of prey. The large canids are marked not only by their body design, but by their sociality and dependence on cooperative group hunting that distinguishes them from other carnivorans like the felids, mustelids, and pinnipeds. Monogamy also distinguishes the large canids from many other mammals, among which it is otherwise rare, roughly three to nine percent (Lack, 1968; Reichard, 2002). While both coyotes and wolves are monogamous and pairs may stay together for life, the wolf is far more reliant on a stable pack structure to reproduce and hunt large prey (Mech, 2006; Shivek, 2015).

Those intense bonds between pack members made the wolf a perfect candidate for humans to first domesticate some 40-23 Kya and, ironically, much easier for humans to nearly wipe out in the 20th century. The coyote in contrast, is a pragmatic generalist, as they can form

stable packs capable of even taking deer or hold small slices of urban territories as life-long pairs, or as lone transients, on the move looking for a territory and mate (Hennessy et al., 2012). The greater dietary plasticity of *C. latrans*, including small mammals, birds, insects, and a surprising amount of fruit like persimmons and berries, would also prove to be a significant advantage to the species (Mowry and Wilson 2019; Mowry et al., 2020).

Another clue that should be taken from this discussion is a remarkable autogenic response *C. latrans* employs when they face top-down trophic pressure from other predators like wolves, which usually kill coyotes on sight (Crabtree and Sheldon 1999). When larger predators kill the majority of local coyotes or other competition, female coyotes modify their litter sizes, from two pups to over a dozen, having significantly larger litters when predation pressure is high and rival numbers are low, and smaller litters when habitats are saturated (Beckoff,1976; Gese, 2005; Crabtree and Sheldon 1999; Shivik, 2015; Flores, 2016). It must also be noted that besides being highly territorial, the breeding coyote female in a pack, like wolves, usually suppresses the reproduction of female subordinates hormonally, meaning only one, dominant female reproduces in a given territory (Beckoff, 1976). Further on in our story we will see how this unique parcel of *C. latrans* biology will become of paramount importance in the outcomes of the human-coyote story.

At the very tail end of the Pleistocene more discernible differences crystalized between *C. lupus* and *C. latrans*. Modern coyote morphology, their body size, limb length, and dentition are all thought to have evolved *very* quickly during this tumultuous time, potentially as fast as only a thousand years after the megafauna Quaternary Extinctions (Meachen and Samuels 2012; Meachen et al., 2014). In the waning days of the Pleistocene the coyotes who dodged the last of the dire wolves were more robust than average modern *C. latrans* (up to 20 percent

larger). However, by the time the dire wolves finally went extinct just ~9 Kya, Holocene coyotes, now modern sized, were on average ~10-20 percent smaller at 25-45 lbs. (Meachen and Samuels 2012; Perri et al., 2021).

Meachen and Samuels (2012) conducted an extensive comparison of the post skeletal morphology of Pleistocene and Holocene aged coyotes and gray wolves. Interestingly, while coyote body size had changed dramatically and extremely rapidly, they found little morphological difference between Pleistocene and Holocene wolf populations in size or limb length (Meachen and Samuels 2012). The authors hypothesized that the changes in coyote body size were not directly related to temperature change at the end of the Pleistocene, as modern *C. latrans* body sizes do not follow Bergmann's rule, which predicts that body size increases with decreasing temperature to maintain body heat. Instead, Meachen and colleagues suggest that Pleistocene coyotes were more robust in response to trophic pressure from larger carnivores and prey (Meachen et al., 2014).

Other notable changes can be seen in the modern coyote's dentition when compared with larger Pleistocene versions, which may have been more dedicated to hyper-carnivory, having larger carnassial teeth for shearing meat off bigger bodied prey. Supporting that interpretation are the smaller occlusal surfaces on the molars of larger Pleistocene coyotes, indicating they spent much less time processing fruits like persimmons, which modern coyotes readily consume (Christopher Mowry, 2021, personal conversation). Today's coyote, though still a predator (and the new de facto apex predator in much of N. America), was winnowed down by the evolutionary gauntlet of the Quaternary Extinctions and is now much more of an omnivorous generalist.

Throughout their evolution, they are shown repeatedly to be flexible survivors, marked by extreme phenotypic, reproductive, and dietary plasticity, seemingly a canid jack of all trades. The reproductive strategies they employed and the niches *C. latrans* filled as a medium sized opportunist seem to have all lined up the coyote's stars in just such a way that the animal is now able to thwart nearly all human efforts to exterminate them, as human persecution actually activates the responses they evolved to survive intense competition with wolves and other predators. That conclusion seems to partially answer our first question- how coyotes able to eventually exploit humans instead of being wiped like other native predators in the early 20th century in N. America. Parsimoniously, this all matches up with thousands of years of indigenous narratives about coyotes as shape shifting survivors, and the context of that ethnographic record is where we shall head for the next leg of our inquiry into the coyote-human story.

CHAPTER 2

Coyote Finishes the People and Other Hominin Mythologies of an American Canid

I will follow the white man's trail. I will make him my friend, but I will not bend my back to his burdens. I will be cunning as a coyote. I will ask him to help me understand his ways, then I will prepare the way for my children, and their children. The Great Spirit has shown me - a day will come when they will outrun the white man in his own shoes.

-Many Horses, Oglala Sioux, 1890

Our investigation, having begun some 40 Mya in the late Eocene now brings us a great distance forward in time, to the beginning of the Holocene (12,500 to 500 years ago) when *C. latrans* encountered a new and strange creature on the landscape. While the coyote had never seen the likes of humans, the coyote would not have been so alien an animal to these immigrants, who after all, had brought domesticated wolves with them when they walked and kayaked to the Americas (Perri et al., 2021). After the descendants of these first peoples split off into separate colonization groups some had made their way to the American Southwest by 12 Kya (Hoffeckler, 2014), and were occupying parts of Arizona by at least 9.5 Kya, where they shared desert grasslands with coyotes, puma, mule deer, jack rabbits, and antelope (Breitburg, 1996).

However old the first human occupations of N. America eventually prove to be, what followed them was a period of population growth that led to human habitation in much of the Americas by 10,000 years ago. Despite persistent notions about Pre-Columbian N. America being an “untouched Eden,” summed up by William Denevan as the “Pristine Myth” (1992), the

first people in the New World built massive earthworks, spread grasslands, tended orchards, and conducted extensive agriculture using irrigation and controlled burning (Denevan, 1992; Hody and Kays 2018). Thus, most of the wilds of N. America had already been "trammeled by man" for thousands of years before Europeans arrived. Human activities in the Holocene inadvertently provided more suitable habitat for the kinds of rodents that have always parasitized human settlements, and which are the preferred prey of smaller canids like coyotes and foxes. Those smaller canids also seek out open spaces, in contrast to wolves, who hunt large prey in more wooded habitats (Mech, 2006; Hinton et al., 2018).

As human population expansion in the Pre-Columbian New World accelerated, (at its peak possibly as many as 60-80 million people) the coyote capitalized on well fed rodents, a general absence of large predators around people, and increases in open spaces provided by human hands (Koch et al., 2019). In contrast to today, for the great majority of the time humans and coyotes shared North and Central America, the coyote was not described as a villain or an invasive pest, rather *C. latrans* was widely regarded as a clever survivor, adept hunter, and ubiquitously associated with ancient supernatural forces. From a wealth of ethnographic accounts from tribes like the Pomo, Achomawi, Apache, Atsugewit, and Miwok, the coyote features heavily in the cultures of numerous peoples from the area of the country that is now California, New Mexico, Arizona, and Utah (Powers, 1877; Barrett, 1906; Bois, 1906; Dixon, 1908; Krober, 1925).

Coyote stories often frame him as a complicated character, almost always blending both benevolent and selfish actions (Dixon, 1908; Lopez, 1977; Kennedy, 2018). The animal was also an embodiment of a powerful Prometheus-like deity who frequently interceded on the behalf of humanity, stealing fire for the People as *Itsappe* (Old Coyote) in the oral traditions of the

Shoshone, and a culture hero who created humans and taught them how to sing, dance, and hunt among the Nez Perce (Lopez, 1977; The Northwestern Band of the Shoshone Nation, 2005; Dashnaw, 2014). Because of his widespread and ancient fame, several authors have suggested that Coyote, still alive and well in many indigenous cultural traditions today, may be the oldest continuously worshipped deity in N. American (Lopez, 1977; Cooper, 1987; Lynch, 2004; Flores 2016; p. 38).

There is good evidence for this in the etymology of the modern word "coyote." The sound most people use today to denote the animal, pronounced ki-yo-tee or ki-yote depending on one's regional parlance, is very old and comes by way of European adoption of a Mexica Spanish word, whose root can be traced directly to the Aztec Náhuatl *cóyotl*, which refers to both the actual animal and a figurative "trickster" (Flores, 2016). In Aztec mythology the coyote deity is known as *Huehuecóyotl*, which like the Shoshone name *Itsappe*, infers great age and translates to Old-old-coyote, indicating that the Aztecs and N. American tribes were all referring to what must have been an ancient god.

Similar to narratives of southwestern tribes, the Aztec version of the Coyote deity is associated with male sexuality, luck, mischief, revival from the dead, choral singing, dancing, and storytelling (Hyde, 2013). In Central America Old-old-coyote was a part of the pantheon of Tezcatlipoca (Smoky Mirror) Mexica gods and this is where his shapeshifting abilities stem from, which is also in keeping with his northern reputation as a shapeshifter. From the surviving Aztec stories some of his most notable lovers were Temazcalteci, the goddess of bathing and saunas, and Xochiquetzal, the goddess of flowers, love, female sexuality, prostitutes, and young mothers (Spranz, 1975). Further alluding to Coyote's cultural connections to sexuality is his rule over the day sign in the Aztec calendar named *cuetzpallin* ("lizard"- which has phallic

connotations in Náhuatl) and the fourth day trecena *Xochitl* ("flower," with feminine associations in Náhuatl). In the Codex Borbonicus he is depicted as having human hands and feet, being followed by a group of humans playing music and dancing, not worshipping or sacrificing. In this way Old-old-coyote stands out sharply as an Aztec deity because of his benevolence towards humans and willingness to sometimes intercede on behalf of those who'd had especially bad luck, which is unusual among the Aztec's generally bloodthirsty assortment of gods (Saville, 1899; Spranz, 1975).

Having briefly covered several thousand years of physical and religious connections between the first N. American humans and *C. latrans*, our discussion will now explore Claude Levi-Strauss's anthropological interpretations of indigenous trickster myths about coyotes. Levi-Strauss warrants mentioning because he has waxed at some length about trickster myths and posed a question pertinent to our discussion directly: "Why is it that throughout North America the Trickster role is almost everywhere assigned to either coyote or raven" (Levi-Strauss 1963; p. 224).

He appears to answer this question by framing the trickster figure as a liminal mechanism which exists between Life and Death categories because it neither kills nor grazes its food, and so, the trickster role is relegated to what are commonly characterized as scavenging animals. The justification for this appraisal is linked to Life's association with agriculture and herbivory, while Death is associated with hunting, warfare, and killing. In Levi-Strauss's appraisal, Coyote thus falls into a gray category, as he is not a hunter nor an eater of grass. For Levi-Strauss' purposes, falling between these distinctions is the entire point of the trickster figure, because he is a carrion eating sort of freeloader and a symbol of resurrection continuously springing from, or literally fed by, death. While this reasoning is clever, and Coyote is indeed

nearly immortal in his tales, Levi-Strauss's version has little to do with actual indigenous Coyote stories (Harris 1979; p. 200-201; Carroll, 1981).

The vast majority of ethnographic and historical accounts of indigenous stories involving Coyote getting his food do not discuss him as a carrion eater, but a hunter among tribes as diverse as the Pawnee, the Kutenai, the Apache, the Salishan, Sahaptin, Mandan, Hidatsa, and the Navajo (Dorsey, 1904; Boas, 1917, 1918; Beckwith, 1937; Opler, 1938; Goodwin, 1939; Hill and Hill 1945; Reichard, 1947; Harris, 1979). Besides the body of ethnographic evidence, biologically speaking, Levi-Strauss's characterization of trickster animals as "not hunters," is also inaccurate. While animals commonly employed as trickster figures like jackals and ravens will avidly scavenge (as do most predators), these species, while being omnivorous and opportunistic, hunt and kill other animals for food. Ravens commonly kill other small animals, even the calves of large ungulates, by pecking their eyes out (Harris, 1979; p. 200-201).

For a more contemporary telling of an indigenous coyote myth, we shall finish this short part of our journey by visiting one of the most enduring and well-known coyote stories: Coyote Finishes His Work or Coyote Finishes the People. This story comes from a Nez Perce oral tradition and was retold by famed nature writer Barry Lopez (1977):

> "From the very beginning, Coyote was traveling around all over the earth. He did many wonderful things when he went along.
>
> He killed the monsters and the evil spirits that preyed on the people. He made the people and put them out in tribes all over the world because Old Man Above wanted the earth to be inhabited all over, not just in one or two places.
>
> He gave all the people different names and taught them different languages. This is why people live all over the country now and speak in different ways.
>
> He taught the people how to eat and how to hunt the buffalo and catch eagles. He taught them what roots to eat and how to make a good lodge and what to wear.

He taught them how to dance. Sometimes he made mistakes, and even though he was wise and powerful, he did many foolish things.

But that was his way.

Coyote liked to play tricks. Sometimes he would go too far with some trick and get someone killed. Other times, he would have a trick played on himself by someone else. He got killed this way so many times that Fox and the birds got tired of bringing him back to life.

He thought about himself all the time, and told everyone he was a great warrior, but he was not. Another way he got in trouble was trying to do what someone else did. This is how he came to be called Imitator.

Coyote was ugly too. The girls did not like him. But he was smart. He could change himself around and trick the women. Coyote got the girls when he wanted.

One time, Coyote had done everything he could think of and was traveling from one place to another place, looking for other things that needed to be done. Old Man saw him going along and said to himself, "Coyote has now done almost everything he is capable of doing. His work is almost done. It is time to bring him back to the place where he started."

So Great Spirit came down and traveled in the shape of an old man. He met Coyote. Coyote said, "I am Coyote. Who are you?"

Old Man said, "I am Chief of the earth. It was I who sent you to set the world right."

"No," Coyote said, "you never sent me. I don't know you. If you are the Chief, take that lake over there and move it to the side of that mountain."

"No. If you are Coyote, let me see you do it."

Coyote did it.

"Now, move it back."

Coyote tried, but he could not do it. He thought this was strange. He tried again, but he could not do it.

Chief moved the lake back.

Coyote said, "Now I know you are the Chief."

Old Man said, "Your work is finished, Coyote. You have traveled far and done much good. Now you will go to where I have prepared a home for you."

Then Coyote disappeared. Now no one knows where he is anymore.

> Old Man got ready to leave, too. He said to the people: "I will send messages to the earth by the spirits of the people who reach me but whose time to die has not yet come. They will carry messages to you from time to time. When their spirits come back into their bodies, they will revive and tell you their experiences.
>
> Coyote and myself, we will not be seen again until Earthwoman is very old. Then we shall return to earth, for it will require a change by that time.
>
> Coyote will come along first, and when you see him, you will know I am coming.
>
> When I come along, all the spirits of the dead will be with me. There will be no more Other Side Camp. All the people will live together.
>
> Earthmother will go back to her first shape and live as a mother among her children. Then things will be made right."
>
> Now they are waiting for Coyote.

In the story Coyote Finishes the People, Coyote is revealed to be a fallible character, who represents the duality of human nature, everyone's power to do good and great deeds while still being imperfect. Thus, Coyote is an amorphous character capable of being both a savior and a buffoon. He fights monsters, but also lies about being brave, and thieves, but steals fire for the people. His pranks sometimes get people killed but he is himself immortal. Thus, Old-old-coyote is essentially the ultimate anti-hero. Broadly, the use of these kinds of comedic trickster-archetypes tests the bounds of possibilities and order among various cultures. Recently, western science has noticed that indigenous people's stories contain thousands of years of ecological memories, which are of great value to the record of empirical knowledge. Keeping that in mind, the other, and perhaps most presciently chilling message to be taken from this ancient story is the ecological warning that when Coyote returns and shows himself to the people, it will be a sign of great, even terrible, environmental change, and that the Old Man will soon return, bringing with him all the spirits of the dead to remake and set the world right again (Lopez 1977: p. 2).

CHAPTER 3

Puritans, Progressives, and Predators

Defenders of the short-sighted men who in their greed and selfishness will, if permitted, rob our country of half its charm by their reckless extermination of all useful and beautiful wild things sometimes seek to champion them by saying ‘the game belongs to the people.’ So it does; and not merely to the people now alive, but to the unborn people.

-Teddy Roosevelt, 1916

Our recent discussion of a Nez Perce myth in which Coyote comes back from the dead to show himself to the People as warning of an impending environmental apocalypse appropriately brings us to the age of the Columbian Exchange and the subsequent Great Dying, which would see the Americas emptied of some ~40- 80 million indigenous peoples within a generation of contact with Europeans (Denevan, 1992; Cook, 1998). This Great Dying occurred as waves of Europeans introduced various Old-World diseases, like smallpox, influenza, and the bubonic plague. A study from 2019 estimates 56 million indigenous peoples died in these events, or 90 percent of the Pre-Columbian population- which is estimated to have been 10 percent of the global population in the 1600’s (Koch et al., 2019). All of which made the Great Dying of the Americas the largest known human mortality event in proportion to global population, and second in terms of sheer numbers only to WW2, when 80 million people died- three percent of the global population (Koch et al., 2019).

Some historians believe that this depopulation of the Americas directly facilitated European domination of the world, via the extraction of resources such as coal and vast, ancient hardwood forests for ship building. The resulting Industrial Revolution, which started first in Europe, culminated in a larger, second version in America (Aberth, 2007). The Industrial Revolution in turn, appears to have led to the acceleration of a new geological age some call the Anthropocene and has perhaps even brought us to the door of the next 6th mass global extinction (Dirzo, 2014; Pimm et al., 2014). Biologically, recent coyote population expansion is in a very real way in keeping with the Nez Perce story Coyote Finishes His Work, as *Canis latrans* has made an almost supernaturally unstoppable return, from Mexico to Canada to Florida, coinciding with this small window of dizzyingly swift ecological change.

The first European settler colonialists who came to the Americas were brought by many factors but tales of abundant natural resources like fur bearing animals and “pristine” lands for farming would surely have been alluring to those in the crowded and often foul cities of Europe. Obviously, the hardships, starvation and generally hardscrabble life most early colonists experienced was the more common reality. After towns and communities were established, it became clear to many of the people in charge that laws would have to be enacted to protect both privately held livestock and local wild game to avoid a “tragedy of the commons" in which everyone faced the specter of starvation, especially in winter.

Auspiciously, one of the very first wildlife laws in the colonies was a wolf bounty created by the General Court of the Massachusetts Bay Colony in 1630. Soon after in 1632 the Virginia state government also established a bounty on wolves (Organ et al., 2012). However, predictably, these bounties did little to nothing to improve deer and small game numbers, as it was the colonists themselves who were decimating the woods with axes, muskets, and

snares. The first official game taking regulation was enacted in Portsmouth, Rhode Island in 1646, when the county limited their white-tailed deer (*Odocoileus virginianus*) season from May 1 - November 1 and declared a penalty of 5 pounds for poaching deer out-of-season (Organ et al., 2012). By the year 1705, the General Assembly in Rhode Island realized that their laws were not effective at preventing poaching, as deer continued to be taken out of season and the population continued to shrink every year. In 1739 The General Court of Massachusetts deputized armed men with the authority of the colonial government, known as "deer reeves," to enforce the laws first enacted in 1698, and each town was required to outfit and employ by appointment no less than two deer reeves.

By the mid 1700's the fine for a deer poaching conviction was steep by colonial standards, 10 pounds, roughly the equivalent of $1,000 today, and incentivized the deer reeves' enthusiasm for catching poachers by awarding one-half of the fine to the deer reeve. Such a fine was levied against Azariah Seldon of Hadley, Massachusetts, who was convicted in 1763 of killing a deer out of season and forced to cough up the full fine of 10 pounds to avoid being put on an auction block and sold for two months of labor. However, hunger makes people do things they probably would think better of otherwise and by the beginning of the 1800s there were so few deer left to protect that most communities had abandoned the employ of deer reeves (Organ et al., 2012).

America's journey toward its conceived Manifest Destiny continued, as did western expansion, and in 1804 Thomas Jefferson would commission Merriweather Lewis and William Clark's famous mapping expedition. When Jefferson sent Lewis, then his assistant, off with the instructions to find a river route to the Pacific, he also told Lewis to "observe the animals of the country generally, & especially those not known in the U.S., the remains, and

accounts of any which may be deemed rare or extinct," (Jefferson 1803, p. 2; Ambrose, 1996). Jefferson had hoped the mysterious and wild frontiers of the west may yet be refuges for living mastodons or giant ground sloths, whose fossils he had recently examined (and whose claws he thought might belong to some giant monstrous cat). Of course, all the great Pleistocene beasts were long gone, but during the four year, 8,000-mile adventure from Missouri to the Pacific Ocean and back, Lewis and Clark discovered and recorded 122 animal species, including the grizzly bear, pronghorn, and the prairie dog (Lewis papers, 2002).

The expedition's first coyote encounters occurred on September 18th, 1804, during a voyage from the Niobrara River in Nebraska to the Teton River in South Dakota. The animal was at first mistaken for a timber wolf, but upon killing one and inspecting its proportions it was clear it was no timber wolf. Clark would call it the "Prairie Wolff," and recorded: "I killed a Prairie Wolff, about the size of a gray fox, bushy tail head and ears like a Wolff, Some fur burrows in the ground and barks like a Small Dog," (Auerbach, 2016). The coyote would be referred to as a prairie or brush wolf until, in 1833, Thomas Say finally gave the species a Latin name- *Canis latrans*, "barking dog," while on an expedition to the Rocky Mountains (James et al., 1823; Burchsted, 1993).

At the precipice of the 20th century, nearly two hundred years after the first game hunting regulations were enacted in the U.S, many species had already been wiped out or driven to the brink of extinction by unregulated hunting and pest control. To fully answer our first question, how the coyote not only thwarted human persecution but thrived off it, and to have some hope of understanding how America's current model of conservation evolved- our story must now account for some of the breathtaking amount of life that was extinguished so rapidly in N.

America. How and why extinction was allowed to happen, and even actively pursued for some species, but not others, can tell us much about where we are today.

As the 1800's drew to a close the demand for N. American furs in Europe had nearly exterminated Southern Sea otters (*Enhydra lutris nereis*) and beavers (*Castor canadensis*), while the Carolina Parakeet (*Conuropsis carolinensis*), one of only three parrot species native to N. America, did go extinct, at least partially, in service to the hat plume trade (Morgan, 1868; Naiman, 1988). Frank Chapman, the bird curator for the American Museum of Natural History and a respected member of the Audubon Society, played some part in that demise while on an expedition to collect specimens from the Atlantic coast of Florida in 1889. Having found the rare birds, he exuberantly wrote, "I have met *Conuropsis* and he is mine," (Nijhuis 2021; p. 64). Originally planning on collecting only four, he had killed nine by the time he reflected in his journal, "...far be it from me to deal the final blow." A unique behavior of the parakeets, flocking defensively around fallen group members, made their collection all too easy. Despite realizing he should stop, Chapman succumbed further to the temptation of the bird's beauty and poignant rarity- indeed, this colony could be the last he, or possibly anyone, would ever see again in the wild, and so, he couldn't help himself, "The parakeets tempted me and I fell; they also fell, six more of them," (Nijhuis 2021; p. 64).

Other species, representing enormous masses of native biotic energy, like the passenger pigeon (*Ectopistes migratorius*), were also extinguished in the name of pest control, progress, and profit. *Ectopistes* had migrated in flocks so vast, numbering in the millions, that their passing was said to have blackened skies for hours and that the collective sound of their wings could be deafening. John James Audubon described experiencing a migrating flock's passing in the year 1813 in Ohio (Audubon 1835; p. 320):

> The air was literally filled with Pigeons; the light of noon-day was obscured as by an eclipse; the dung fell in spots, not unlike melting flakes of snow, and the continued buzz of wings had a tendency to lull my senses to repose...I cannot describe to you the extreme beauty of their aerial evolutions, when a hawk chanced to press upon the rear of the flock. At once, like a torrent, and with a noise like thunder, they rushed into a compact mass, pressing upon each other towards the center…. Before sunset I reached Louisville, distant from Hardensburgh fifty-five miles. The Pigeons were still passing in undiminished numbers and continued to do so for three days in succession. The people were all in arms. The banks of the Ohio were crowded with men and boys, incessantly shooting at the pilgrims, which there flew lower as they passed the river. Multitudes were thus destroyed. For a week or more, the population fed on no other flesh than that of Pigeons, and talked of nothing but Pigeons.

Total population estimates range from three to five billion, and researcher Arlie W. Schorger believes they may have once been the most numerous birds on Earth, accounting for between 25-40 percent of all birds in N. America at one time (Schorger, 1955). The species' role in creating forest disturbances, by breaking large branches while roosting, is thought to have been linked to greater vertebrate diversity in forests and the proliferation of vast oak forests across the continent (Hutchinson, 2012; Chih-Ming, 2014). Their huge murmurations and raucous communal roosts must have been incredible spectacles of nature, and so, the birds were not hard to find. Technological advances like the telegraph, invented in 1844, meant the whereabouts of flocks could be shared quickly, and their extermination as crop pests became coordinated across states.

Shooting tournaments, in which teams shot as many captured birds as possible, became lively traveling events. The last recorded breeding roost of the passenger pigeon occurred in 1878 in Petoskey, Michigan, where an astonishing 50,000 birds were killed each day for almost five months (Fuller 2001; p. 50). The adults who escaped Petoskey attempted a second nesting site but were killed by professional hunters. Once numbering up to as many as five billion at their peak, the last wild passenger pigeon was shot in 1901 and the last captive bird, Martha, died in an aviary cage on September 1st, 1914, at the Cincinnati Zoo. In a strange and sad twist of fate, the last captive Carolina parakeet, a male named Inca, died in the same cage at the Cincinnati Zoo four years later (Tallman et al., 2002; Snyder, 2004).

Several trophic cascades occurred after the removal of the passenger pigeon, such as increases of other acorn mast feeding animals, like the white-footed mouse, whose numbers exploded (Ostfeld et al., 1996). The extinction of passenger pigeons, along with the extermination of predators, have since been linked to the sharp increase in tick-borne Lyme disease seen today, as overly abundant white-footed mice and white tail deer are some of the most prevalent reservoirs of *Borrelia burgdorfer* (Ceballos et al., 2015). The extinction of the pigeons not only had significant impacts on ecology, but the subsistence patterns of indigenous peoples. The passenger pigeon, besides being pickled and canned by the barrel by Europeans, had been an abundant food source for tribes for thousands of years, like the Seneca, who called them *jahgowa*, meaning "big bread" (Schorger, 1955).

Unlike Europeans, who described the pigeons as the “perfect scourge,” largely because they raided crops and flocked in such bizarrely huge numbers, to indigenous peoples they were a bountiful gift. Among game birds, they were second to only the wild turkey (*Meleagris gallopavo*) in terms of subsistence importance for the Native Americans living in the

southeastern U.S, as the bird's fat was stored in large quantities for winter larders. Archaeological evidence also supports the idea that native Americans depended heavily on the pigeons prior to colonization (Ellsworth, 2003; Fuller, 2001). However, in a brief summation of the settler colonialist species cleansing and genocide in N. America that would eventually lead to explosive coyote expansion, it is probably the buffalo (*Bison bison*) that best summarizes the federal war on endemic life and indigenous people as one kind of "problem."

President Andrew Jackson, well aware that the plains tribes relied heavily on the buffalo, encouraged the army to shoot them on sight around the same time the Indian Removal Act of 1830 was made law, and bounties were enacted on both indigenous people and nuisance animals (Isenberg, 2000). Later men in the service of the federal government were also aware that abundant buffalo (and wild free ranging horses) were a central component to the "Indian problem." General William Tecumseh Sherman, eventually tasked by President Grant with removing Indians from the plains, would mention the "Indian/buffalo problem" in his letters repeatedly, and had written a letter to General Philip Sherridan, dated May 10th, 1868, reflecting that wherever large herds roamed (Sheridan Letters, 1868-1877):

> Indians will go there. I think it would be wise to invite all the sportsmen of England and America there this fall for a Grand Buffalo hunt and make one grand sweep of them all. Until the Buffalo and consequently Indians are out from between the Roads we will have collisions and trouble.

Ultimately the government's Indian/buffalo problem would solve itself, when, by the year 1870, buffalo hides began commanding as much as three dollars and fifty cents (Waltman, 1971). The Army, who never had an "official" buffalo removal policy, had only to sit back and

wait for Progress to do their work for them. In 1874 both the House and Senate passed legislation that would prohibit the wanton waste of buffalo and protect breeding females, but President Grant refused to sign the bill (USFWS Timeline, 2021). Besides independent skinners, thousands in bounties were paid to commissioned gunners such as William F. Cody (aka Buffalo Bill) by corporations like the Kansas Pacific Railroad Company (Flores, 2016). The animals were shot en masse where railroads were being laid, as the herds were a menace to trains when they milled about on tracks.

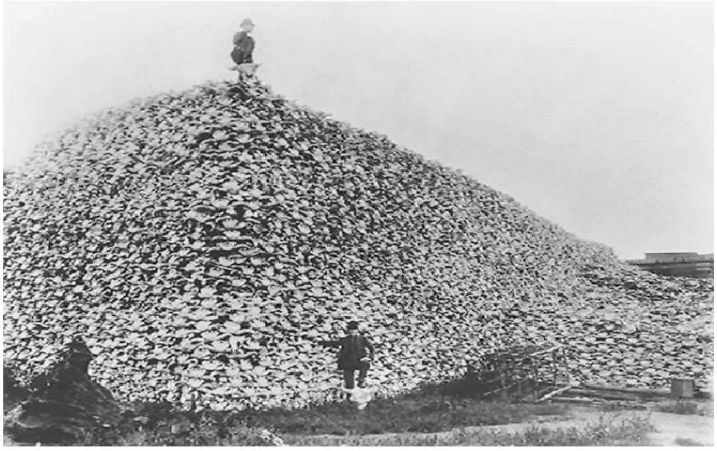

Figure 1.1 Buffalo skulls to be ground into fertilizer, 1870. Image credited to the Burton Historical Collection, Detroit Public Library.

Outside of bounties and the export of their valuable skins, other industries rose from the buffalo bones that accumulated across the plains. Bison bone, primarily skulls, sold by the ton for between $2.50- $15.00, and was used to refine sugar, in the production of fine bone china, and ground into nitrogen rich fertilizer which was shipped across the county via railroad car (Cumo, 2015). By the year 1880, the buffalo, whose migrations had rivaled any of the African Serengeti, were nearly gone, reduced to less than 600 animals (Aune, 2017). Today it seems fair to wonder what part those tons of bison bone fertilizer and the annihilation of the passenger

pigeon, representing an almost unimaginable loss of biomass, had in the genesis of the ecological disaster that would be the Great Dust Bowl some scant 30 years later.

The Great Dying that began with European colonization and the deaths of millions of indigenous people had never ended and continued in the form of extirpation of wildlife, and finally, Americans began to notice. People across the country were becoming alarmed about what was being lost around them, as the landscapes of N. America were denuded not only of pests like predators and passenger pigeons, but treasured species like elk, sheep, pheasant, deer, and ducks. Not even the greatest trees on Earth, the sequoia and redwoods, were spared and were felled by the acre at an eye watering speed. In response to a spreading and now shared sense of unease, between 1874-75, some 100 sportsmen's organizations were founded largely out of local community concerns over game bird declines, and by 1878, 308 organizations had declared a commitment to some form of game conservation practice (Nijhuis, 2021).

The work of writers like David Thoreau and Waldo Emerson, and the western landscape paintings of artists like Thomas Cole, all began to reach audiences in the east around the same time. Educated citizens in urban centers suddenly became more interested in the patriotic conservation of the grand and uniquely American wonders they read and saw in these works. Thus, an age of romanticism began and a young nation's hunger for national identity building seized the populace. The first National Park, YellowStone, had recently been established in 1872, and Sequoia National Park and Yosemite would follow in 1890. Further change was coming, when in 1887, Teddy Roosevelt, (who would become the 26th president in 1901) founded the Boone and Crockett Club, a society of politically well-appointed and powerful sportsmen (Reiger, 2001).

Roosevelt called on men he believed also saw the value of setting aside America's wilderness and big game in the name of preserving a vigorous American spirit and masculinity they feared was being watered down by Progress, immigration, and city living (Flores, 2016; Nijhuis, 2021). Other founding members included: George "Bird" Grinnell (the founder of the Audubon Association), Madison Grant (a founder of the NY Zoological Society), General William T. Sherman (of Civil and Indian Wars fame), and Gifford Pinchot (the first director of the Forest Service). On a blisteringly cold day in December of 1887, Roosevelt invited nine men to his home in New York to discuss his ideas for the activist sportsmen group he envisioned. George Bird Grinnell would write years later about the reasons they all agreed to form the club (Reiger 2001; p. 4):

> We regretted the unnecessary destruction of game animals, but we did not know what it meant, nor did we have the vision to look forward and imagine what it portended. So we discussed in a general way the preservation of game, it must be confessed–in the light of the later events–that we were talking of things we knew very little. We wanted the game preserved, but chiefly with the idea that it should be protected in order that there might still be good hunting which should last for generations.

Later, the same year the club was formed, the New York State Assembly passed the Adirondack Deer Law, a new kind of game law. The law banned the "jacklighting of deer" or using lights to blind deer and hunt them at night and forbade shooting deer after using hounds to drive them into lakes. One of the most important things to note about the nature and language of the statute, and many that quickly came after it, was that nothing about deer populations or conservation of wildlife in general was mentioned. Instead, the point was that it outlawed spotlighting and hounding deer to water because this behavior, and market hunting in general,

was perceived by men like Roosevelt and Grinnell as unsportsmanlike behavior both demeaning to game and a grave threat to the future of their beloved sport (Organ, et al., 2001). The Adirondack Deer Law signals a discernible turn in the history of American wildlife laws and still has overt implications for how state and federal (and even global) wildlife management is conceived and conducted today.

Regardless of several facets of the law that may make it attractive to nature lovers today, what remains clear is that these measures were not generated by any kind of benevolent concern for wildlife or land for its own sake. Indeed, the men who founded the Boone and Crockett Club had collected enough wildlife, via holidays in a global range of colonialist territories, to fill an ark. Instead, the overtly Utilitarian motivations behind the first of these kinds of laws show themselves to be driven by notions about which people had a right to public lands, and wildlife like elk, duck, deer, and moose. The Adirondack Deer Law, and the general ethos of the Boone and Crockett Club, at its best, was shaped by a philosophy of hunting best summed up by the doctrine of fair chase.

Fair chase was defined by the club as: “the ethical, sportsmanlike, and lawful pursuit and taking of any free-ranging wild, native North American big game animal in a manner that does not give the hunter an improper advantage over the game animals,” (Geist et al., 2001; Organ et al., 2012). The language of fair chase, and the foundational idea of wildlife as a “public” resource was eventually woven into state game laws by several members of the Boone and Crockett Club, who agreed it was the only way to ensure the nation’s most prized game species did not share the fate of the Carolina parakeet or the buffalo. At the time, almost none of these ideas were extended to predators, and it would be nearly a century before N. American conservation would start to catch up with biological reality (Nelson et al., 2011).

Energized by advances in science and industrial technology, much of European and American society saw their time as a new age with nearly unlimited potential to “improve” every factor of living. Eugenics, a new field of science borne by this spirit, was first coined by British scholar Sir Francis Galton (1883) in his book, *Inquiries into Human Faculty and Its Development*. Galton’s book was a smash hit and seen as another new frontier in biological science (Gillhan, 2001). Gary Brechin has suggested that there is a direct line between “conserving the race” and “conservation of resources” as many well educated and affluent American and European eugenicists were active in both movements from 1900 to the 1950’s (Brechin, 1996; Garland, 2013). Today, eugenics and conservation may seem to be ideas that are at odds and have very little in common.

However, common to both movements was the goal of selectively preserving the “best,” only the best people, only the best landscapes, and only the best animals. Annihilation of predators in game management, forced removal and genocide of indigenous people, and the sterilization of those deemed "degenerates," all sprung from the same perceived supremacy of modern biological interventions in the name of improvement (Brechin, 1996; Garland, 2013). Various prominent men in politics, biology, philosophy, and human anatomy were openly espousing these kinds of ideas, and besides eugenics, theories such as phrenology and polygenism blossomed and spread like a fungus among the educated classes (Jackson, 2005; Zeidler and Sadler 2000).

Roosevelt, Pinochet, Madison Grant, W.T. Sherman, and John Muir all embraced such ideas as well (Brechin, 1996). For example, Roosevelt thought sterilization of the “feeble-minded” and the “habitual criminal” would alleviate many of the problems in crowded immigrant slums (Roosevelt, 1914). He feared that if eugenic actions were not taken, the United

States would be submitting to a slow “race suicide,” meaning that some imagined robust American breed of human, shaped by the rigors of taming the American frontier, its peoples and animals, would be diluted by breeding with inferior immigrants and generally atrophy due to crowded city living (Dyer, 1980; Larson, 1991; Garland, 2013). As well, and perhaps even more telling, was Roosevelt’s overtly hostile feelings toward indigenous peoples of the continent, who he perceived as a threat to America’s birthright to dominion over the landscape. At the same he was beginning to strategize how to save his beloved game species and scenery, Roosevelt would give a speech in New York in 1886 regarding the preservation of the Indian, “I don't go so far as to think that the only good Indian is the dead Indian, but I believe nine out of every ten are, and I shouldn't like to inquire too closely into the case of the tenth,” (Hagedorn 1921; p. 355).

Other forefathers of conservation, like William Hornaday, a renowned museum taxidermist who almost single-handedly saved *Bison bison* from going extinct by breeding them at the Bronx Zoo (with Roosevelt’s blessing as president), was also a raging anti-Semite who lamented how his familiar New York had become alien to him because it had been taken over by the “Jews from the slums of Riga” (Nijhuis, 2021; p.40). To save the buffalo Hornaday would eventually release a herd in 1907 to lands in the Wichita National Forest in Oklahoma. Lands from which the Kiowa, Comanche, and Apache had all been forcibly driven off of (Spiro, 2009). Madison Grant, another founder of the Boone and Crockett Club and a wealthy socialite, was also a respected young conservationist who helped found the New York Zoological Society.

Grant vociferously supported the enforced elimination of game markets and helped inspire the Adirondack deer laws with his paper “The Vanishing Moose and Their Extermination in the Adirondacks” (Madison, 1894). Grant, one of the very few early conservationists who publicly supported conservation of predators, also found subsistence hunting vulgar. He was

particularly offended by Italian immigrants who hunted songbirds and squirrels for food in New York's city parks, and even proposed banning firearm ownership for immigrants (Garland, 2013). Outside of his zoological studies Grant wrote *The Passing of the Great Race* in 1916, and the book detailed his anxieties over the extinction not of animal species, but, like Roosevelt's American breed, some imagined great Nordic breed of human being, also threatened by dilution with immigrants in urban settings (Grant, 1916). Once it was translated into German, Adolf Hitler would herald many of Grant's ideas and would refer to the book repeatedly in public (Kühl, 1994). Lines from Grant's *Passing of the Great Race* were more recently muttered by right-wing Norwegian terrorist Anders Breivik in 2011 before he killed seventy-seven people (Nijhuis, 2021).

Because so many of the men who were foundational to state and federal conservation philosophies held these kinds of beliefs about other human beings, it is clear why they would have woven them into their visions of wildlife management. Notions that some animals and people were good and useful while others were inherently inferior or harmful legitimized persecution of predators and indigenous peoples in a misguided attempt to improve the kind of ecology these people wanted. In many ways these notions still decide which animals essentially get coddled by state and federal agencies, like elk fed hay by wildlife agencies hoping to increase their numbers on degraded rangeland, and dictates which animals, like coyotes and wolves, are poisoned and shot from planes. Today, if we want to know why the century old federal war against one 30 lb. native canid continues despite its obvious futility- the role of colonialism, genocide, eugenics, and species cleansing must be acknowledged as much a part of N. America's conservation legacy as love of geese and picturesque vistas.

CHAPTER 4

The Great Dying That Never Ended

Our Father who art in nature, who has given the gift of survival to the coyote, the common brown rat, the English sparrow, the house fly and the moth, must have a great and overwhelming love for no-goods and blots-on-the-town and bums, and Mack and the boys. Virtues and graces and laziness and zest. Our Father who art in nature.

-John Steinbeck, 1942

By the early 1900's ranchers were becoming increasingly worried about growing support for land conservation efforts and talk in Congress of collecting grazing taxes on public lands. The most powerful and politically connected began to lobby Congress members from their states to protect their interests, and, thus, this period in history seems to have irrevocably put a burgeoning conservation movement and livestock production on a course set for more than a century of conflict. Similar conflicts between ranchers and conservationists had already been brewing in states like Montana, Wyoming, and Idaho for years, as the newly minted national parks were facing heat from both ranchers and game hunters because they were viewed widely as "predator havens," which were thwarting the effort to make the public lands as predator-free and profitable as possible. In 1897 a New Mexico rancher, Author Tisdale, is recorded as the first person to officially petition his state government to "do something about the predator problem," (Flores 2016; p. 94).

During this time, despite mounting regulation of hunting seasons, game species like elk, quail, bighorn sheep, and ducks were still in decline across the country, and alarmed sportsman, ranchers, and even birding organizations like the Audubon Society (then the Audubon Association) embraced the notion that native predators like eagles, wolves, and pumas were part of a shared national "predator problem." While it sounds unbelievable today, until 1917 the leadership of the Audubon Association declined to publicly oppose the shooting and poisoning of birds of prey like peregrine falcons, great horned owls, ospreys and even a paid bounty on bald eagles enacted by the Alaska Territorial Association (Nijhuis 2021; p. 69). At the turn of the 20th century, N. American predators had very few friends, and not even John Muir would meaningfully take up for grizzlies, eagles, lions, or wolves in the national parks, let alone vermin like coyotes, foxes, and bobcats.

In 1905 the Division of Economic Ornithology and Mammalogy, once a small and unremarkable government agency that conducted surveys on migratory bird populations and pest management related to deer and crop yields, was renamed the Division of Biological Survey (Flores, 2016). That year Vernon Bailey was named chief field biologist for the division, and wrote *Wolves in Relation to Stock, Game, and the National Forest Reserves*, in which he stated his belief that national parks were indeed refuges for predators, though he maintained that lions and coyotes killed more livestock than wolves (Survey of Biological Survey, 1905; Schmidly, 2018). Bailey also proposed that his division of duck and deer counters could better serve the country as part of the final "predator solution."

Having read Bailey's work, Forest Service chief and Boone and Crockett Club founding member Gifford Pinchot would take him up on his offer and put the Division to work removing predators from national forest lands. Bailey documented the Division's work and successes in the

publication *Destruction of Wolves and Coyotes: Results Obtained During 1907,* which details how the Division used strychnine baits, snares, and buried animals alive in dens to remove some 2,000 wolves and 23,000 coyotes in their first year (Flores, 2016; Schmidly, 2018). Eventually, the proscriptions of a game-centered conservation concept led to the management of the fledgling national forests and parks as curated ideals of wilderness, man-made living dioramas where surviving native predators, like the First Nations peoples who had survived the Great Dying, had no place in the carefully planned scenery anymore.

John Muir was lucky enough to live to see his dream of the national parks realized and is today largely viewed as the equivalent of a saint within the environmental movement for his efforts. However, he is recorded as finding a band of Miwok Indians still living in the newly established Yosemite to be "dirty" and "lazy," and a cumbersome threat to tourists, wildlife, and the sanctity of the pristine natural cathedral he imagined the park to be (Spence, 1999; Simmons et al., 2016; Nijhuis, 2021). From this mentality a line leads directly to what is today called "fortress conservation,"- whereby indigenous people (and unwanted wildlife) are removed or kept out of their ancestral lands in the name of conservation.

These paradigms are often most rigorously enforced where colonialism has left the worst scars and results in indigenous people being removed, killed, or blocked access to their traditional subsistence patterns by means of fences, violence, guns, and guards (Brockington, 2002). A decade into a new and romantic century of exploration and science, the general sentiment toward indigenous people and native predators like the coyote seems well summed up by a passage in A.R Harding's handbook for the amateur bounty hunter *Wolf and Coyote Trapping* (1909; p. 4):

> The coyote bears the same relation to the wolf family that the Apache Indian does to the human race. It is a belief among some of the Apaches that they turn into coyotes when they depart this life, and nothing will induce one of them to kill a coyote. Like the Indian he is sneaky and treacherous, and full of the devil.

After the Division's initial success in the National Forests, in 1915 the first allocation of federal predator control funds was made to the Division of Biological Survey, a sum of 125,000 dollars (Flores, 2016). Just five years later in 1920 it had become apparent that shooting and trapping "varmints" individually was inefficient and costly, and it didn't take long for the bureaucratized deployment of lethal compounds and traps to become the Division's most used tools. Soon, federal funds were also allocated to build a laboratory for animal experimentation with toxicants in Albuquerque, New Mexico, to supply the national effort.

Figure 2.1(Above) Cougars killed for hides and bounties. Public domain photo credit: https://upload.wikimedia.org/wikipedia/commons/30/Market_hunting_of_cougars.jpg

Figure 3.1(Below) Bobcat and coyote hunters. Image credited to the Wisconsin Historical Society, Image ID:91003https:// www.wisconsinhistory.org/Records/Image/IM91003.

The first of these labs, like something out of a particularly nightmarish Richard Adams yarn, was named the Eradication Methods Laboratory, where many of the most terrible chemicals and devices ever used to exterminate wildlife were conceived and tested. A year later the lab was moved to Denver, Colorado, and then in 1928 was renamed the Control Methods Research Laboratory. Renaming and relocating again and again almost continuously over the century would be a recurring theme of the Division and its toxicant labs (Shivik, 2015; Flores 2016).

Strychnine, in tablet and powdered form, had been used widely in N. America since the 1850s, when carnivore bounty hunters poisoned bison or horse carcasses and came back a few days later to collect their handiwork. However, much to the dismay of sheep ranchers the orneriest coyotes, possibly spooked by the smell of poison or humans on carcasses, survived. In

this way, unlike wolves and pumas, coyotes evaded lethal removal in pockets of the west for generations and held on fast as other predators were removed from entire states (Hinton et al., 2019). The people at the Biological Survey were aware of this old snag and focused on increasingly clever ways to disperse strychnine and cyanide, and eventually even more awful compounds like thallium sulfate, which kills slower, days or weeks after ingestion, leading to no learned association with baited carcasses. Thallium sulfate also results in hair loss and blindness before death, meaning animals often ultimately slowly die of exposure and starvation (Flores, 2016; Micke and Wolf 2000).

Eventually, even more novel forms of biological warfare were experimented with by the Interior Department and under the direction of Glacier National Park's superintendent James Galen, several unfortunate coyotes purposely infected with sarcoptic mange were released into the park by veterinarians with the hope of spreading the scourge to resident carnivores (Flores 2016; p.100). Obviously, not just coyotes, bobcats, and wolves were affected by this toxic onslaught and in 1921 a veritable plague of rabbits, having fewer predators to control them, is recorded as descending across multiple parts of the west, eating every green thing they could reach. Summarily, the Biological Survey suggested poisoning the rabbits too, and soon received approval and funding to begin. In a single year in Idaho 600,000 rabbits were baited or trapped and 61,000 pounds of their hides were collected for sale (Hawthorne, 2004).

Similar boom and die-off cycles were observed in mule deer around the Grand Canyon, in what has been called the Kaibab Deer Plateau Episodes and still stands as a contentious bookmark in the history of trophic cascade theory. In one season 60 percent of the Grand Canyon rim's mule deer (*Odocoileus hemionus*) starved to death after their population skyrocketed from some 4000 deer to nearly 100,000 (Leopold, 1933, 1943, 1944, 1949; Rasmussen, 1941).

According to some like Aldo Leopold the mule deer boom coincided with a blitzkrieg strychnine baiting campaign that had wiped out most of the rim's lions and coyotes (Leopold, 1933; Ripple, 2005). A few years later in Kern California another boom of field mice would result in populations so thick their crushed corpses covered stretches of highway (Flores, 2016).

While population booms do sporadically occur in rodent species naturally, such as lemmings, that these irruptions all coincide with poisoning campaigns seems too great a coincidence to ignore (Leopold, 1944). Prey species irruptions, primarily of deer and rodents, began to occur following widespread wolf extirpations, with most of the western irruptions (80 percent) eventually taking place between 1935 and 1945 (Ripple 2005; p. 641). Oblivious to the ecological havoc they wreaked, lethal control campaigns continued and increased in number, and in 1923 Colorado alone put out 31, 255 poisoned baits. Only three years later in 1926 hunters for the Bureau of Biological Survey reported almost no wolf remains recovered from the state (Flores 2016; p. 100).

However, the coyote, like its characterization by First Nations as a slippery trickster who defies death, proved far more elusive and harder to exterminate than solitary pumas or wolves (Mech, 2006). Unlike wolves, the coyotes' flexible social strategy and their omnivory meant they were perfectly evolutionarily primed to respond to human persecution as they would have pressure from other larger predators. Another adaptation that sharpened the coyote's edge- the autogenic reproductive response we first observed the coyote using in the face of intense predator pressure during the Pleistocene Quaternary Extinctions. As during the Pleistocene when coyote populations are persecuted, survivors adapt, increase breeding, and recolonize (Hinton et al., 2019). The constant disruption of their social groups by humans this time had the same effect- subordinate and transient female coyotes reproducing more often and at earlier ages. With

the additional boon of the extirpation of other predators, and rodent irruptions, more food was available, which breeding pairs were able to funnel into larger litters (Hinton et al., 2019; Hody and Kays 2018; Kays et al., 2020). Here we seem to have finally answered our second question- how *Canis latrans* managed to not only survive but thrive in the face of human persecution. The rest of our inquiry into this time period can tell us how the federal tradition of war with predators further solidified the coyote's edge and shaped their ecology.

Propelled outward by the wake of anthropogenically triggered recolonization, coyotes were on the move across the country by at least the 1920's, finding abundant rodents, increasingly fragmented open landscapes, and little to no resistance from anything but humans and domestic dogs (which, before national leash laws were brought on by anti-rabies campaigns in the 1950's, were still effective at keeping them out of towns and suburbs). By the beginning of the Prohibition Era coyotes had crossed the Mississippi river, bred with some of the last of the southeastern red wolf refugees (*Canis rufus*), and claimed states across the southeast as their own (Hody and Kays 2018; Hinton et al., 2019; Kays et al., 2020).

A decade later in the 30's, during the worst days of the Great Depression, and as the Great Dust Bowl choked large parts of Kansas, Texas, Colorado, and Oklahoma, the fortunes of *C. latrans* were decidedly looking up. The coyote populations who had survived the peak of predator species cleansing in America had successfully passed through another evolutionary gauntlet, this time a very small anthropogenic one, almost as small as the one dogs must have had to cross. Except this time, the canids on the other side of this human gauntlet weren't our adoring and helpful best friends, but a rapaciously adaptive canid shaped by more than a million years of evolution and efforts by humans to eradicate their species from the earth.

By this time, it had also begun to dawn on the men in charge at the Bureau of Biological Survey that the organization, now spending only three percent of their annual budget on conducting science or any form of actual biological survey, had performed their extermination duties perhaps too well, and that they suddenly needed a new reason to continue to exist and receive annual funding quickly. States and cities had already begun to turn their attention to coyotes, and in 1938 the city of Los Angeles paid out 650 bounties on coyotes (Flores, 2019; p. 200). The slinking and shy coyote, whose howl or sighting was suddenly more noticeable, and increasingly out of place in an otherwise predator-free landscape, would do as America's new "arch predator."

The paradox we must confront at this point in our investigation is that at the same time the federal government was spending so much money to solve the "predator problem," more evolved ideas about land and habitat conservation were becoming known. Conservation legislation, originally crafted by wealthy sportsmen, had first related to migratory birds and game, but by the 1930's it was clear to some Americans that a focus only on game laws would not be enough to stem the continuous loss of wildlife and land. From within agencies like the Interior Department and professional organizations like the Society of Mammalogists, scientists, park service employees and even members of birding organizations like the Audubon Association (such as fire-brand suffragette Audubon member and bird of prey activist Rosalie Edge) began to rebel against outdated Utilitarian anti-predator paradigms (Frank, 1924; Leopold, 1933; ASM 1999, 2012; Nijhuis, 2021).

CHAPTER 5

Leopold's Legacy and the Fight for the Future of Conservation

One of the penalties of an ecological education is that one lives alone in a world of wounds. Much of the damage inflicted on land is quite invisible to laymen. An ecologist must either harden his shell and make believe that the consequences of science are none of his business, or he must be the doctor who sees the marks of death in a community that believes itself well and does not want to be told otherwise.

-Aldo Leopold, A Sand County Almanac, 1949

One of the most influential and earliest advocates for change was Aldo Leopold, who was both a professional member of the Boone and Crockett Club (invited to the club in 1923) and a graduate from the nation's first school of forestry, (endowed at Yale University by George "Bird" Grinnell), as well as a founding member of the American Society of Mammologists. After graduation Leopold took jobs as a forestry assistant in the Arizona territories in 1909, and two years later, in 1911, was transferred to New Mexico, where he stayed until 1924. By this time, Leopold had seen many changes to the American landscape and concluded that a new kind of preservation of land would be needed due to the rampant spread of the automobile and the paved highways and roads which were made to accommodate them. He was the first to employ the term "wilderness" to talk about preservation of roadless lands, and over the next twenty years, he would further build upon these ideas, eventually blending ethics and empirical science in his defense of that wilderness.

His experiences in land management would inspire him to write the textbook *Game Management* in 1933 (Leopold, 1933), in which he made the case for scientifically rigorous management policy, that put facts over feelings about animals and begged for sensible compromises between ranchers and conservationists. However, it was his early years that would set him on a course for a grander ethical reckoning (Leopold, 1949). On a sunny afternoon in New Mexico in 1909, he was eating lunch with a group of workers when they noticed an animal crossing a gully below them. It was a fateful afternoon, and its impressions would inspire one of the most revered and oft quoted chapters from Leopold's *Sand County Almanac*, Thinking Like a Mountain (Leopold 1949; p. 137-139):

> We were eating lunch on a high rimrock, at the foot of which a turbulent river elbowed its way. We saw what we thought was a doe fording the torrent, her breast awash in white water. When she climbed the bank toward us and shook out her tail, we realized our error: it was a wolf. A half-dozen others, evidently grown pups, sprang from the willows and all joined in a welcoming melee of wagging tails and playful maulings. What was literally a pile of wolves writhed and tumbled in the center of an open flat at the foot of our rimrock. In those days we had never heard of passing up a chance to kill a wolf. In a second we were pumping lead into the pack, but with more excitement than accuracy: how to aim a steep downhill shot is always confusing.
>
> When our rifles were empty, the old wolf was down, and a pup was dragging a leg into impassable slide-rocks. We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then, and have known ever s'ince, that there was something new to me in those eyes something known only to her and to the mountain. I was young then, and full of trigger-itch; I thought that because fewer wolves meant more deer, that

no wolves would mean hunters' paradise. But after seeing the green fire die, I sensed that neither the wolf nor the mountain agreed with such a view.

Since then I have lived to see state after state extirpate its wolves. I have watched the face of many a newly wolfless mountain, and seen the south-facing slopes wrinkle with a maze of new deer trails. I have seen every edible bush and seedling browsed, first to anaemic desuetude, and then to death. I have seen every edible tree defoliated to the height of a saddlehorn. Such a mountain looks as if someone had given God a new pruning shears, and forbidden Him all other exercise.

In the end the starved bones of the hoped-for deer herd, dead of its own too-much, bleach with the bones of the dead sage, or molder under the high-lined junipers. I now suspect that just as a deer herd lives in mortal fear of its wolves, so does a mountain live in mortal fear of its deer. And perhaps with better cause, for while a buck pulled down by wolves can be replaced in two or three years, a range pulled down by too many deer may fail of replacement in as many decades. So also with cows. The cowman who cleans his range of wolves does not realize that he is taking over the wolfs job of trimming the herd to fit the range. He has not learned to think like a mountain. Hence we have dustbowls, and rivers washing the future into the sea.

The passages in the Thinking Like a Mountain chapter are often misinterpreted as Leopold's "ethical ecological awakening," and the recount of some singularly primordial experience with a dying she-wolf which left the forester changed indelibly from that day forward. In reality, Leopold penned the events of that afternoon 35 years after it had happened, from the great distance of experience, field observations, and decades of deep self-reflection of

his actions. While it is a less romantic version of Leopold's legend, for years after that afternoon he would go on to kill many more native predators in the name of land management. However, even in those early days he was taking note of the boom and die-offs of prey species that resulted from extermination of predators and other deleterious effects caused by poor land mismanagement he saw around him.

Those observations eventually led Leopold to develop a new concept of ecology which conceived of the land and *all* the life forms it contained as part of one "biotic community" as he would call it- to which man ultimately belonged, whether he knew it or not, and to which he had moral obligations as a "plain member." After *Game Management*, Leopold continued to refine his ideas about ethics toward nature as a still evolving facet of man's moral growth as a species (Leopold, 1949):

> The first ethics dealt with the relation between individuals; the Mosaic Decalogue is an example. Later accretions dealt with the relation between the individual and society. The Golden Rule tries to integrate the individual to society; democracy to integrate social organization to the individual…There is as yet no ethic dealing with man's relation to land and to the animals and plants which grow upon it. The land-relation is still strictly economic, entailing privileges but not obligations… The extension of ethics to this third element in human environment is, if I read the evidence correctly, an evolutionary possibility and an ecological necessity. It is the third step in a sequence. The first two have already been taken. Individual thinkers since the days of Ezekiel and Isaiah have asserted that the despoliation of land is not only inexpedient but wrong. Society, however, has not yet affirmed their belief. I regard the present conservation movement as the embryo of such an affirmation.

The above ideas are the basis of Leopold's "Land Ethic" (1949), which he conceived as an ethical turn in the evolving relationship of a mature, industrialized human society's responsibilities to the natural world. While Leopold has often been criticized for being vague in his proscriptions, because both trophy hunters and animal rights activists quote and canonize him, he seemed to know then that he did not have all the answers but that an increasingly just and rationale society would likely evolve into them (1949):

> I have purposely presented the land ethic as a product of social evolution because nothing so important as an ethic is ever 'written.' Only the most superficial student of history will suppose that Moses 'wrote' the Decalogue; it evolved in the minds of a thinking community, and Moses wrote a tentative summary of it for a 'seminar." I say tentative because evolution never stops. The evolution of a land ethic is an intellectual as well as an emotional process.

Leopold's ideas and later publications called for valuing entire systems (Leopold 1919, 1930, 1933, 1948; Ripple, 2005). His own evolution in thinking about predators can be seen in his writings about coyotes, lions, and wolves, and significantly, Leopold had himself been pondering the seemingly unexplainable expansion of the coyote. While on a trip to Mexico in 1937 he observed that *C. latrans* had not yet taken the Sierra Madre Mountain range, which was wild enough to still have remnant Mexican wolves (*Canis lupus baileyi*) populations (Leopold 1937; p.120):

> There are no coyotes in the mountains, whereas with us there is universal complaint from Alaska to New Mexico that the coyote has invaded the high country to wreak havoc on both game and livestock. I submit for conservationists to ponder the

> question of whether the wolves have not kept the coyotes out? And whether the presence of a normal complement of predators is not, at least in part, accountable for the absence of corruption? If so, would not our rougher mountains be better off and might we not have more normalcy in our deer herds, if we let the wolves and lions come back in reasonable numbers?

Regardless of arguments over who gets to decide what constitutes “reasonable numbers" of predators today, of course his inklings about predators preventing ecological “corruption” were correct. Today the phenomenon he pondered is called a “mesopredator release,” whereby the absence of large carnivores results in the release of smaller predators and omnivores (Crooks and Soulé 1999). In his review of *The Wolves of North America* (Young and Goldman 1944), Leopold, further evolving his ideas, expressed concern that deer irruptions were not being accurately linked to predator extirpations (Leopold 1944; p. 929):

> Entirely unmentioned in the book is the modern curse of excess deer and elk, which certainly stems, at least in part, from the excessive decimation of wolves and cougars under the aegis of the present authors and of the Fish and Wildlife Service. None of us foresaw this penalty. I personally believed, at least in 1914 when predator control began, that there could not be too much horned game, and that the extirpation of predators was a reasonable price to pay for better big game hunting. Some of us have learned since the tragic error of such a view and acknowledged our mistake.

Around the same time Leopold’s first textbook, *Game Management*, was published several things happened that seem to have dramatically swung the pendulum away from his progressive ideas and set history on its present course. The Biological Survey would inherit more

funding and power than ever before when, in 1931, the Animal Damage Control Act was passed by President Hoover (U.S. Public Law 776). The act empowered the Secretary of Agriculture to "conduct campaigns for the destruction or control of animals considered threats to agriculture/ranching interests" (Flores, 2016; p. 114). A year after Leopold's *Game Management* (1933), *The Report of the Chief of the Bureau of Biological Survey* (1934) was released and declared that the public lands had indeed become "breeding reservoirs for predators and rodents...which re-infested stocked and cultivated areas," (Leopold, 1933; Bureau of Biological Survey, 1934; Flores 2016; p. 114).

The same year $35,752 was allocated to the Bureau of Biological Survey to continue their work, and a whopping $404,062 in public funds were devoted to continued toxicant production (Flores, 2016). The Animal Damage Control Act, born 101 years after the Indian Removal Act of 1830, solidified the federal government's legitimate involvement in "animal damage control" at every trophic level, from grasshoppers to grizzlies, and was ultimately crafted, like the Indian Removal Act, for the purpose of funding the government's war against native life. Despite all the money, sweat, and death poured into the "predator problem," representing 3.567 million poisoned baits strewn across the country, coyotes shook it all off, and in the late 1930's were still expanding their numbers (Flores, 2016; Hinton et al., 2019).

Between 1939 and 1948 the Biological Survey was split and renamed several more times, and by 1948 would be known as the Branch of Predator and Rodent Control and Wildlife Enhancement, and then eventually as Wildlife Services. Despite the long list of names and directors over the years, the main charge of the old Biological Survey remained the same over the decades- "managing" wildlife in the name of human interests. However, monumental social driven change in environmental politics, not seen since the Progressive Era, was on its

way. Unfortunately, Aldo Leopold would not live to see this great change in environmental thinking, as 1948 was the year he succumbed to a heart attack at the age of 61 while helping a neighbor fight a brush fire. His most read and often quoted work, *A Sand County Almanac, Sketches Here and There* (Leopold, 1949) was published the next year. It was well reviewed but some of the most radical ideas of the book, concerning man's ethical duty to a biotic community, would not get their due for some time.

As the 1960's got under way a decade ripe with scientific wonders and social revolution began. Racheal Carson, who had herself once been employed by the Forest Service in the 1930's, published her bombshell work *Silent Spring* in 1962 (Carlson, 1962). Carson's meticulous work brought awareness to the public of the many dangerous pesticides and chemicals, like DDT, which were used widely and without regulation in the United States. Thus, *Silent Spring* was met with fierce opposition by pesticide companies. Already aware of her research and upcoming book, in 1959 the USDA, who used thousands of gallons of pesticide a year, preemptively released a film titled*: Fire Ants on Trial*, which defended the government's policy of dumping pesticide (including on playgrounds) across the country by plane to fight invasive fire ants (Lear, 1997).

Monsanto would follow suit the same year *Silent Spring* was published with 5000 copies of a pamphlet called "*The Desolate Year*" (1962) which painted a world pushed back to the Middle Ages without pesticides, suffering famine and disease borne by an apocalyptic explosion of pests. A biochemist who specialized in industrial cyanamide, Robert White-Stevens, called her, "a fanatic defender of the cult of the balance of nature," and said of Carson's call for a critique of DDT, "If man were to follow the teachings of Miss Carson, we would return to the Dark Ages, and the insects and diseases and vermin would once again inherit the earth," (Lear,

1997; p. 434). A year after publication, the impact of Carson's *Silent Spring* had reverberated through the minds of Americans, and an increasingly alarmed citizenry was again demanding their government respond, this time to hazardous chemicals. Despite opposition to Carson's message by powerful chemical corporations and attacks on her that ranged from calling her a communist to a nature-worshipper, her work led to a nationwide ban on DDT ten years later in 1972. Perhaps most importantly, *Silent Spring* ultimately inspired an environmental movement that led to the creation of the U.S. Environmental Protection Agency (EPA) (Nijhuis, 2021).

After Carson's warnings about pesticides like DDT, conservationists were demanding Kennedy's government review the use of dangerous toxicants like strychnine, cyanide, sodium sulfate and Compound 1080 to kill wildlife. In response, in 1963 Kennedy's Secretary of the Interior Stewart Udall appointed an Advisory Group on Wildlife and Game Management to review the continued use of toxicants and other lethal measures. Most appropriately the group was led by none other than Starker Leopold, son of Aldo Leopold. Starker was by then himself a professor of zoology at the University of California and had little love of the Biological Survey (renamed again as the Bureau of Sport Fisheries and Wildlife), and their sloppily implemented management of wildlife.

The review Starker wrote, delivered to Secretary Udall in 1964, was innocuously titled *Predator and Rodent Control in the United States*, though it is now better known as the Leopold Report. The report was critical of the randomly implemented use of toxicants and proposed six recommendations (Leopold, 1964):

Recommendations of the Leopold Report of 1964

---

(1) Appoint an advisory board that oversaw all lethal control implantations and methods.

(2) Reassess the goals of the predator and rodent control programs.

(3) Revise the predator and rodent control guidelines.

(4) Expand research programs.

(5) Establish legal control over the use of certain pesticides.

(6) And, finally, change the name of the organization yet again (Leopold, 1964).

In the recommendations section Starker Leopold wrote about the substantial changes that would be required to reform the state-federal agency (Leopold 1964; p. 27):

> …the Branch of Predator and Rodent Control has become an end in itself and no longer is a balanced component of an overall scheme of wildlife husbandry and management. In the opinion of this Board, far more animals are being killed than would be required for effective protection of livestock, agricultural crops, wildland resources, and human health. This unnecessary destruction is further augmented by state, county, and individual endeavor. The federal government, it would seem, should be setting an example in the proper scientific management of all wildlife resources, with a view to total public interest and welfare. Instead, the Branch of Predator and Rodent Control has developed into a semi-autonomous bureaucracy whose function in many localities bears scant relationship to real need and less still to scientific management. It is our recommendation that there be a complete reassessment of the goals, policies, and field

> operations of the Branch of Predator and Rodent Control with a view to limiting the killing program strictly to cases of proven need, as determined by rigidly prescribed criteria.

Secretary Udall eventually adopted several of the proscriptions of the Leopold Report by 1965 and changed the name from the Bureau of Sport Fisheries and Wildlife to the Division of Wildlife Services, and created two branches within that Division, the Branch of Wildlife Enhancement and the Branch of Pesticide (Flores, 2016). Despite these changes many of the reforms were in word only, as cyanide, traps and aerial gunships continued to be used by Wildlife Services, and still are today. Following the exposure of harm done to wildlife by government agencies and chemical corporations, a new sense of ecological awareness continued to grow, its unruly tendrils reaching the hearts and minds of every part of American society (Tober, 1981). This new public awareness culminated in the passage of the National Environmental Policy Act (NEPA) in 1969 and the creation of the Environmental Protection Agency (EPA) in 1970 (Eccleston, 2008).

In 1971 several environmental nonprofits sued the Department of the Interior to finally get a total federal ban of toxicants on public land. In response to this political heat, in 1971 the Cain Report was commissioned by Secretary of the Interior Roger Morton to review progress since the Leopold Report. Cain's report did not mince words (Cain et al., 1971; p. 133):

> ...the substantial monetary contributions by the livestock industry serves as a gyroscope to keep the bureaucratic machinery pointed towards the familiar goal of general reduction of predator populations, with little attention to the effects of this on the native wildlife fauna. Guidelines and good intentions will no longer suffice. The federal-

> state predator control program must be effectively changed. It must take full account of the whole spectrum of public interests and values, not only in predators, but in all wildlife. This will require substantial, even drastic, change in control personnel and control methods, supported by new legislation, administrative changes and methods of financing.

Richard Nixon surprised many environmentalists by signing Executive Order 11643 on February 8th, 1972, which took Cain's recommendations to heart and banned the use of toxicants by Fish and Wildlife Service agents (Shivik, 2015). Constituting what was arguably one of the longest reaching acts of his presidency, and the most sweeping U.S. environmental act ever passed, in 1973 Nixon also signed the Endangered Species Act of 1973. The wolf and the puma were the first animals given the new federal protection. The law was and still is revolutionary, because it warrants protection to *all* endemic species, from whales to tiny fish like the snail darter (Doub, 2013). Since its passage, the ESA is credited with saving at least 46 species from extinction, including the bald eagle and the humpback whale, and remains popular with Americans on both ends of the political spectrum (George et al., 2016; Bruskotter et al., 2018). Eventually, the ESA was also adopted by 80 other nations and continues to define global wildlife management efforts (Enzler and Bruskotter 2009).

However, despite all these successes, in the decades that followed, the legislation of taxpayer funded toxicants on public lands would become a kind of political football that subsequent administrations would use to appease one base or the other. After Nixon resigned, Gerald Ford reinstated authorization for toxicants in predator management, which Jimmy Carter banned again (Kaufman, 2006). Reagan, who promptly had Jimmy Carter's solar panels ripped off the white house roof after his election win in 1980, predictably brought back authorization for

costly taxpayer funded wildlife poisoning campaigns, as well as signed a law to make it legal to once again kill mother wolves and bears with young in their dens (Dearen, 2012). Obviously, politically driven convolutions of policy vault conservation practices back and forth through the years and the administrations, and continue to do so today (Richards, 1999).

CHAPTER 6

The North American Conservation Model

There is a French saying that he who desires a beautiful park must have a very sharp ax, and a heart of stone.

-Valerius Geist, 2019

In the late 1980's and early 1990's American game management practices continued to be formalized and literature concerning an American theory of conservation began to percolate among wildlife professionals, eventually giving rise to what is today called the North American Conservation Model (NAM) (Geist, 1995; Geist et al., 2001; Organ et al., 2012; Mahoney and Geist 2019). The first "official" form of the NAM was published in V. Geist, Shane Mahoney, and John Organ's "Why hunting has defined the North American model of wildlife conservation," in 2001 (Geist et al., 2001; Organ et al., 2012). Their paper, first presented at the 66th North American Wildlife and Natural Resources Conference (a wildlife professional organization), was both a historical account of hunting's role in conservation history in the U.S, and a codified set of seven wildlife management principles, which Geist first articulated in the 90's (Geist, 1995).

The seven tenets blended the philosophies of the Boone and Crockett Club, The Wildlife Society and, seemingly, Aldo Leopold's demand for science-based wildlife policies as well. Those principles, now only some 20 years old, have become the manifesto of Wildlife Service professionals, and are repeated on the websites and publications of state-federal wildlife agencies

across the country (Nelson et al. 2011; Peterson and Nelson 2016). Below are the seven tenets and pertinent caveats to its application as they are stated:

Table 3.1 The Tenets of the North American Conservation Model

1. Wildlife Resources are a Public Trust. In the North American Model, wildlife is held in a public trust (Hare and Blossey, 2014). This means that fish and wildlife are shared by the public through state and federal governments. In other words, though a private citizen may own the land upon which wildlife roams, that person does not own wildlife that lives on their private property. Instead, native wildlife is owned by all American citizens (Geist, 1995; Organ et al., 2012). **Caveats**: Application and enforcement of laws to all taxa are at best inconsistent across states. Although state authority over the allocation of the take of resident game species is well defined, county, local, or housing development ordinances can supersede state authority (Organ et al., 2012). Another critique is the charge that wildlife is now disproportionately managed for the benefit of agriculture and game hunters (a very small segment of society). This disregards the non-hunting or non-ranching public who value native predators and species like prairie dogs for their intrinsic and biotic value to ecosystems (Nelson et al., 2011; Ripple et al., 2014).
2. Markets for Game are Eliminated. Commercial hunting and the sale of wildlife is prohibited to ensure the sustainability of wildlife. This principle holds that unregulated economic markets for game and non-game wildlife are unacceptable because they privatize a common public resource and lead to declines. The Lacey Act of 1900 effectively made market hunting illegal in the United States, and the Migratory Bird Treaty Act of 1918 provided international protections from the market (Organ et al., 2012). **Caveats**: Markets exist across the U.S for wild reptiles, amphibians, birds, and fish in the pet trade today. In addition, many native game species are actively bought and traded. Also, no federal law bans "canned hunting"- the sale of captive bred wildlife like elk and oryx to be hunted in enclosures. A market for access to wildlife also occurs across the country in sales of reserved game tags to out of state bidders. Another caveat- it is legal in many states to capture fox and coyotes and sell them to people who train hounds to kill coyotes and foxes in enclosures. This is essentially a legalized form of dog fighting and ignored or even endorsed by state wildlife managers. For instance, the practice is legal in Georgia today, as it was expressly mentioned by the state game commissioners and authors of GA's 2015-2024 Deer Plan, (Forrester and Williams, GA Deer Plan 2015-2024, 2014; p. 27): "In contrast, live sale of

coyotes to commercial fox hunting operations can return profits nearing $100 per animal," (GDNR, 2014).

3. Allocation of Wildlife is by Law.

Wildlife is allocated to the public by law, as opposed to market principles, land ownership, or other status. Democratic processes and public input into law-making help ensure access is equitable. Laws regulating access to wildlife include the 1940 Bald and Golden Eagle Protection Act, Endangered Species Preservation Act and Fur Seal Act of 1966, the Marine Mammal Protection Act of 1972, and the 1973 Endangered Species Act (Geist et al., 2001; Organ et al., 2012).

Caveats: Application and enforcement of laws to all taxa are inconsistent across states, and can often be linked to political, rather than biological realities (Bogezi et al., 2019).

4. Wildlife Can be Killed Only for a Legitimate Purpose.

In principle, under the North American Model, the killing of wildlife must be done only for food, fur, self-defense, and the protection of property (including livestock). In other words, it is broadly regarded as unlawful and unethical to kill fish or wildlife (even with a license) without making all reasonable effort to retrieve and make reasonable use of the resource (Geist et al., 2001; Organ et al., 2012).

Caveats: The fourth tenet is often cited as one of the NAM's most controversial, as it is overtly vague and open to broad interpretations based on personal values. Some people believe trophy hunting or saving cattle are legitimate reasons to kill wild animals, while others do not. As such, there are constant disputes over the legitimacy of lethal removal of native wildlife (Nelson et al., 2011; Treves, 2017; Artelle et al., 2018). Equally problematic are wildlife killing contests like coyote derbies and "rattlesnake roundups," which are tolerated or encouraged by some state and federal agencies, seemingly blatantly violating the 4th tenet (Nelson et al., 2011; Organ et al., 2012; ASM, 2012; Artelle, 2018).

5. Wildlife is Considered an International Resource.

As wildlife does not exist only within fixed political boundaries, effective management of these resources must be done internationally, through treaties and the cooperation of management agencies (Geist et al., 2001; Organ et al., 2012; Artelle et al., 2018).

Caveats: Many positive cooperative efforts have been established among the U.S., Canada, Mexico, and other nations for conserving wildlife. However, NAM's focus on hunting and firearms as central to conservation funding places it at odds with conservation efforts abroad that have begun to question trophy hunting's place in modern and future conservation (Geist and Graves, 2019; Treves, 2017; Artelle et al., 2018).

6. Science is the Proper Tool to Discharge Wildlife Policy.

The North American Model recognizes science as a basis for informed management and decision-making processes. Proper science in wildlife policy includes objective studies of population dynamics, behavior, habitat, adaptive management, and national surveys of hunting and fishing (Geist et al., 2001; Organ et al., 2012). This tenet draws explicitly from Aldo Leopold, who called for a wildlife management facilitated by trained wildlife biologists, and a commitment to shared underlying principles, rather than strictly favoring the interests of hunting and agriculture (Leopold, 1933, 1944, 1949).

Caveats: The sixth tenet has also faced intense scrutiny from NAM's critics (Nelson et al., 2011; Artelle et al., 2018; Treves et al., 2019). Randomly implemented lethal removal of native predators has been disputed by scores of biologists for more than a lifetime now, and the American Society of Mammalogists has directly criticized WS, aka the Biological Survey, and their continued persecution of predators for nearly a century (Frank, 1924; Leopold, 1944; ASM, 2012; Shivik, 2015; Treves, 2017). Wildlife management and conservation in general appears to be extremely politicized today and shows no sign of not being so in the future. Disparate regulations and policies vary across states- and many state legislators oppose conservation efforts such as the ESA and predator reintroduction (Bogezi et al., 2019). That politicization of conservation efforts refutes Wildlife Service's claim, despite their explicit endorsement of NAM, that science is foundational to current wildlife management policies (Artelle et al., 2018).

7. Democracy of Hunting is Standard.

Access to hunting opportunities are guaranteed to the American public by the Doctrine of Public Trust and the Robert-Pittman Act of 1937, which collects an 11 percent excise tax on firearms, ammunition, and bows for conservation funding (Bolen, 2003). Proponents point out this self-perpetuating funding scheme, and access to firearms, are responsible for saving America's wildlife and crucial to continued conservation successes (Geist and Mahoney 2019). If the 6th tenet echoes Aldo Leopold, the 7th clearly heralds Theodore Roosevelt and the Boone and Crockett Club's philosophy that access to good hunting results in benefits to society (Geist et al., 2001; Organ et al., 2012).

Caveats: Taxes on firearms and hunting licenses provide roughly 60 percent of the funding for conservation through the Pittman Roberts Hunting Act of 1937 (Bolen, 2003). Because of this funding scheme some critics have suggested that white, male hunters are extremely over-represented in U.S wildlife management interests and discourse (Nelson et al., 2011; Organ et al., 2012; Treves, 2017; Artelle et al., 2018). As well, reduction in, and limited access to huntable lands compromises the claim of egalitarianism in hunting opportunity. Many Americans, due to geography or cost, do not have access to hunting of ducks, deer, and quail. As well, fewer people are hunting every year, as the hunting demographic ages out of the sport and is currently not being replaced by younger or more diverse members. Instead, a 2016 WS survey showed that the largest increases in the public's wildlife "use" were in "non-consumptive" wildlife users, such as photographers and bird watchers (USFWS, 2016). As the

U.S hunting population grows smaller each year, the long-term viability of conservation funding which is disproportionately shouldered by hunters becomes increasingly questionable (Treves, 2012).

Despite the fact that the tenets of NAM are now ubiquitously promoted on state-federal wildlife management websites, the model has no legal powers of its own (Organ et al. 2012). Instead, the model has come to represent the history, philosophy, and justification for the current policies employed by wildlife professionals, as it is incorporated into state-federal wildlife agency mission statements, as well as endorsed by wildlife management college curricula (Nelson et al., 2011). As we have seen there are significant caveats to the implementation of NAM's tenets and several authors have decried the entire model as "insufficient" (Peterson and Nelson 2016; p 1):

> The NAM is not inclusive enough of diversity among wildlife species or stakeholders. Principles labeled the bedrock foundation of the NAM exist in flux and at the whim of political systems. Belief that the NAM reflects a foundation of laws more stable than the milieu of governance structures shaping wildlife management can encourage complacency among wildlife conservation advocates. Wildlife management exists in systems too complex to be beneficially defined by a terse list of principles.

The first three tenets, "**Wildlife Resources are a Public Trust," "Markets for Game are Eliminated," and "Allocation of Wildlife is by Law,"** pertain largely to the original aims of the Boone and Crockett Club, namely protecting game species from decimation via market forces, by protecting that wildlife through ownership in a perpetual public trust (Geist et al., 2001). Challenges to these three tenets and the first in particular, maintain that state and federal wildlife management is conducted disproportionately in the interest of too few Americans,

namely hunters and the agricultural sectors (Nelson et al., 2011). The second tenet, "**Markets for Game are Eliminated**," also presents several thorny issues which seem to refute the spirit and language of the model. Native wildlife *is* bought, sold, and traded in America, and fully legally, such as the coyotes in Georgia captured by trappers and sold to hounding operations, to be killed by dogs in enclosures with no chance of escape (GDNR, 2015). This practice, besides being morally revolting, is not in keeping with the NAM's second tenet, or the doctrine of fair chase held as sacred to the founders of the Boone and Crockett Club.

The third tenet, "**Allocation of Wildlife is by Law,**" proposes that states and federal agencies regulate access to all wildlife through legislation like the 1940 Bald and Golden Eagle Protection Act, the Marine Mammal Protection Act of 1972, and the 1973 Endangered Species Act (Geist et al., 2001; Organ et al., 2012). However, legislation relating to state management of wildlife varies wildly, and largely across blatantly political lines (Bogezi et al., 2019). In many states the methods of "allocation of wildlife," even if they are legal, do not fall in line with the rest of the tenets of the NAM. For instance, in May of 2021 Idaho's Republican Governor Brad Little passed a measure, Senate Bill 1211, allowing 90 percent of the state's gray wolves (~1,350 wolves) to be culled, citing their removal from ESA protections by the Trump administration in 2020 as justification.

The bill also allocates more taxpayer money to be paid to private trappers to kill wolves, as well as removing welfare protections through public harvesting regulations, allowing wolves to be killed after being chased for miles with snowmobiles or ATVs, clearly not in keeping with the ethics of fair chase. The wolf culling bill is highly popular with Idaho's agriculture industry, as it is expected to cut the state's gray wolf population from about 1,500 to 150. Notably, the bill was opposed by both the Idaho Fish and Game Commission and wildlife organizations like the

Center for Biological Diversity, because it gives politicians control over state wildlife management and not scientists- meaning the Idaho law violates another of the NAM's tenets- "science is the proper tool for wildlife management."

This measure, besides exposing the grimy political motivations for specific kinds of wildlife laws to benefit a small segment of the American public, also represents another betrayal of the NAM tenets, the first, which holds that wildlife is a public trust that belongs to *all* Americans. The tax money spent on trappers and the culling itself will be a flagrant waste of millions of dollars that have already been spent on re-establishing the species under the ESA to the region. As one continues to move down the list, growing ethical questions around several more tenets stand out. One of the most often cited "ethically contentious" tenets is the fourth, "**Wildlife can only be killed for a legitimate purpose**," (Organ et al., 2012). As with most critiques of the model, the fourth tenet is problematic because it is overtly vague. A "legitimate reason" for killing wildlife is open to vast interpretations- some people think a trophy is a legitimate reason to kill an elephant, while others do not (Bruskotter et al., 2018). The same question of legitimacy is attached to the actions of the state-federal agencies that kill thousands of N. American predators annually and preemptively to "protect" game animals and livestock.

In Organ et al.'s. (2012) reappraisal of the model some 10 years after its inception, to their credit, despite insisting that the NAM should remain unchanged and central to wildlife management, the NAM authors acknowledge part of the model's shortcomings. Organ et al. (2012) do this by briefly mentioning predator control, "rattlesnake roundups" and the mass killing of prairie dogs. The authors, however, stop after bringing up these events, offering no solutions or further opinions on the "legitimacy" of persecution of unpopular species besides the following (Organ et al., 2012; p. 19):

> Particularly in the case of snakes, directed persecution occurs along with many in the public sharing the perception that "the only good snake is a dead snake," thus hampering conservation efforts. A lack of monitoring prevents our ability to determine definitive impact on populations.

The model's 5th tenet, "**Wildlife is Considered an International Resource**," refers to the international management of species, as wildlife does not recognize human international borders. As well, this tenet acknowledges that best management practices require international collaboration in the enforcement of laws pertaining to recognized endangered species and their international trafficking (Geist et al., 2001). However, the continued use of trophy hunting, a historical aspect of the NAM, is contentious and will likely remain so in the future. Thus, the NAM's focus on hunting's role in conservation funding may place it at odds with the current global movement for rewilding efforts in modern conservation (Geist et al., 2001; Organ et al., 2012; Artelle et al., 2018).

The other, and probably second most cited critiques of the NAM come from the sixth tenet, which appears at first glance to herald Aldo Leopold's prescriptions, "**Science is the proper tool for wildlife management**" (Geist et al., 2001; Organ et al., 2012; p. 20; Artelle et al., 2018). Wildlife Services and state wildlife divisions have adopted the language of this tenet to defend controversial policies like predator bounties, toxicants, aerial gunning, and wildlife killing contests, by claiming all their policies adhere to science-based management approaches. However, the purported science that justifies mass random predator culling is rarely well defined or even marginally supported by WS's own scientific research and published literature (Gese, 2005; Wallach et al., 2010; Nelson et al., 2011; Artelle et al., 2018). Many researchers have instead pointed out that random lethal removal of predators is rejected by a nearly century-old

body of biological evidence that disputes these methods (Frank, 1924; Leopold, 1934, 1944; Cain et al., 1971; Gese, 2005; Crabtree and Sheldon 1999; Crooks and Soulé 1999; ASM, 2012; Artelle et al., 2018).

To further explore that critique, in a 2018 article, "Hallmarks of science missing from North American wildlife management," Artelle et al., studied the implementation of NAM's proscription for science by compiling a framework made up of four fundamental components to science-based resource management (measurable objectives, evidence, transparency, and independent peer review) (Artelle et al., 2018). They investigated hunt management plans of 62 U.S and Canadian provinces and territories over 667 different management systems (species jurisdictions). Artelle et al. (2018) found that some 60 percent of hunt plans devised by these agencies subscribed to less than half of the four criteria that serve as hallmarks of scientific methodology (Artelle et al., 2018). The authors further suggested that wildlife management systems should be subjected to more rigorous forms of review by uninvolved third parties, as they found that of some nine percent of agencies which reported any kind of review, only six percent were subjected to external review (Artelle et al., 2018). Clearly, this is not in keeping with modern scientific methods, to which external scrutiny is a requisite. All of this raises doubts about Leopold's proscription for scientific impartiality being a basis of predator management in the U.S.

As we arrive at the last and seventh tenet of the NAM, "**The Democracy of Hunting is Standard**" we are brought back to what seems to ultimately tie the model together- the continuation of the dream of the Boone and Crockett Club founders, bountiful game. In the name of that dream the model, primarily through funding schemes, perpetually marries hunting licensing and ammunition sales to conservation funding through the Pittman-Roberts Act, which

allocates some 60 percent of conservation through hunting (Bolen, 2003). Based on this tenet, the literature of state-federal wildlife agencies consistently maintains that management in the name of consumption (hunting), both historically and today, almost alone allows for wildlife conservation to exist (Geist et al., 2001; Organ et al., 2012; Nelson et al., 2011; Treves et al., 2019).

However, according to a 2019 paper published on the topic by Adrian Treves (a frequent critic of the NAM and lethal predator removal) hunting has not been wildlife's savior. He discussed his study before publication in an online interview with Katie Stennes of Project Coyote in 2018, "To our knowledge, there is no evidence that hunting has ever saved an animal population or species from extinction." To better explain that charge let us quote Treves further about his findings (Stennes, 2018):

> My colleagues and I have noticed over the years, however, that conservation science literature and statements by wildlife managers abbreviate the statement "regulation of hunting" to simply "hunting" when referring to methods of intervention that saved species from extinction. We're afraid that this shorthand idea that hunting itself is responsible for protecting wildlife populations is leading to a misunderstanding and misidentification of what the actual conservation intervention is—mainly the regulations that were implemented to stop over-hunting. The implementation of systems including hunting permits, fees and enforcement against over-hunting and poaching were the successful interventions that saved species from extinction—not the act of hunting. Blurring the line between the regulation of hunting and hunting itself is leading to some pernicious consequences.

So, how has Wildlife Service's adoption of the NAM played a part in the current "coyote situation?" Essentially, it appears that managing wildlife to increase valued game species has resulted in the widespread whitewashing of persecution of predators, especially coyotes, which is justified as the "democratic management" of game. To that end, the appeal and persuasiveness of the NAM is frequently used by Wildlife Services to elevate hunting, trapping, and fishing to a special, supposedly crucial, position in wildlife management (Nelson et al., 2011; Treves et al., 2012; Artelle et al., 2018). Besides ideological justifications, the source of state conservation funding also makes wildlife management beholden to very specific interests and demographics of Americans (less than five percent of Americans are hunters), almost entirely those of older, white, rural men (ASM, 2012; Treves et al., 2012).

The Federal Aid in Wildlife Restoration Act of 1937, now referred to as the Pittman-Robertson Act, was signed by FDR in 1937, and eventually amended to include an 11 percent excise tax on firearms, ammunition, and bow hunting gear to provide funds to each state to manage wildlife and improve habitats. States are reimbursed for up to 75 percent of costs associated with habitat improvement and species management, which they choose, design, and implement after getting approval from Wildlife Services (Bolen, 2003). However, these programs disproportionately benefit species like deer, elk, and turkey, and target coyotes for removal all over the country (Nelson et al., 2011). While hunting does have a rich history of conservation successes and most researchers opposed to random lethal predator removal freely acknowledge that and the benefits of hunting (Nelson et al., 2011; Shivik, 2015; Treves et al., 2019), the decline of sport hunting means new funding schemes must be realized soon.

Another reason funding changes should be made- the current funding scheme appears to ensure the financial incentive of state and federal managed "farming" of game species

supersedes any scientific proscription to improve ecosystems by allowing predators to self-manage their own populations and lower prey densities. Challenges to this funding model stir intense resentment in the hunting public, who understandably believe they have traditionally shouldered much of the burden of conservation costs, and so, conservation design and funding should benefit them- on improving deer or turkey numbers by killing coyotes, not on rewilding condors, wolves, and jaguars.

At its best, the NAM model is potentially perpetually self-funding and ensures that the future public has access to wildlife to harvest and wild land to enjoy. At its worst the model's philosophical vagaries, ethical loopholes and beholdeness to increasing "game" for the benefit of a tiny segment of American society will never adequately allow for better wildlife management. As John Shivik points out, two thirds of all state agencies use the word "game" and not "wildlife" to refer to the animals they manage, and this seems telling (Shivik 2015; p. 65). The coyote, and its gross mismanagement at the state and federal level, appears to serve as a kind of emblem for that exact charge against NAM.

To allow the NAM authors to defend their model we will visit a 2019 book by V. Geist and Shane Mahoney, which discusses recent challenges to the NAM (Nelson et al., 2011; Peterson and Nelson 2016; Mahoney and Geist 2019). Valerius Geist, besides being considered one of the foremost ungulate experts in the world, has also written extensively about wolves, their reintroduction, and their proposed dangers to people and wildlife (Geist, 1971; Geist, 2007; Geist and Graves 2009). In a series of essays about wolves republished through the Boone and Crockett Club in 2008, Geist made his case that wolf rewilding efforts are misguided. Notably his views about predators are extremely popular and oft quoted by the hunting public, who largely reject predator reintroduction efforts (Geist, 2007, part 3):

> Alas, the fairy tale by the brothers Grimm, Little Red Riding Hood, is not based on myths, ignorance, or a misunderstanding of wolves. Rather, it is based on very real and terrible experiences with wolves throughout the centuries. Excepting historic Japan, where unarmed peasants cultivated and revered wild wolves as a defense against crop-raiding deer and wild pigs, I have not found instances where unchecked wolf packs lived peacefully alongside people.

Similar sentiments present themselves in Geist and Mahoney's 2019 book, and particularly the chapter they wrote, North American Ecological History as the Foundation of the Model, which opens by pointing out that recent criticisms of NAM should first be addressed by detailing which species are actually "natural" in N. America (Mahoney and Geist 2019; p. 9-10):

> These policies are under scrutiny by a more or less informed, but opinionated and politically active segment of the public, much of it organized into societies that, purportedly, want to protect "nature." The North American Model of Wildlife Conservation, for all its virtues and vices, cannot be discussed in isolation from such powerful claims on America's wildlife and purported best conservation practices. An all too common denominator of these claims, as well as of those concerning rewilding, is an implicit or explicit reference to some idea of what is "natural."

The next page continues on in this vein, and Geist and Mahoney's roundabout way of making their case for man's hands-on management of predators because the continent hadn't been wild since their arrival (Mahoney and Geist 2019; p. 10):

> …modern humans struggled for over 1,500 years before they succeeded in entering the interior of the continent. Evidence from skeletons and cave deposits indicate that they lived miserable lives. Success came with the short-lived Clovis and Haskett luxury

> hunting cultures in North America and the Fishtail-Point Culture in South America. Success carried a high biodiversity cost. Each of these cultures largely exterminated the region's megafauna in about five hundred years each...Thus, in the context of wildlife management and nature conservation in North America, it is important to note that the entry of modern humans at the beginning of the Bølling- Allerød Interstadial some 14,000 years ago marked the last time the continent's biota and landscapes were natural.

In the next several paragraphs Geist and Mahoney continue with their argument (essentially the pristine myth) about what the "natural" state of wildlife was in indigenous hands just before Europeans began to colonize the continent (Mahoney and Geist 2019; p. 16):

> While the evidence for agricultural innovation is well recognized, the American archaeological record also reveals that existing wildlife was so severely exploited at this time that large bodied species became rare and mainly deer and mountain sheep remained...Bison were present deep in the interior but were also heavily hunted, and utilization of game was intense, down to grinding bones for consuming. The extreme depletion of wildlife referenced here is a classic example of Garett Hardin's tragedy of the commons.

Except Geist and Mahoney's version stands in contrast to the language on a South Carolina DNR website about the topic (SCDNR, 2009):

> In pre-Columbian times it is estimated that there were approximately 30 million white-tailed deer in the United States and although deer numbers had declined a great deal by 1800 there was still an abundance of deer. However, during the period 1800-1900 heavy commercial exploitation of deer for meat and hides coupled with habitat

> destruction, poor land use practices, and an ever-increasing human population caused deer numbers to plummet to around 500,000 by the turn of the century.

Geist and Mahoney's previous paragraphs seem to set up much of the rest of their arguments about modern carnivore management, and begins the story of how, instead of species cleansing of abundant buffalo and predators, Europeans ultimately saved these Siberian wildlife immigrants from extinction with colonialism, democracy, and firearms. Geist and Mahoney then address what is a growing body of critique of the NAM model (Frank, 1924; Nelson et al., 2011; ASM, 2012; Peterson and Nelson 2016; Artelle et al., 2018; Treves, 2019) and it seems best to continue to simply let them speak for themselves (Mahoney and Geist 2019; p. 16):

> The American Model of Wildlife Conservation is one of the continent's great cultural achievements. However, its success depends on a functional democracy, an armed citizenry, and public acceptance of the idea of wildlife being a renewable resource for consumption...As in the past, the Model is continues to be under attack (Geist and Mahoney's typo not this author's). It is ironic that despite the great successes of the North American Model of Wildlife Conservation, and the great weaknesses of preservationist models of nature conservation, the former is now viewed by many as politically incorrect, having been formed and traditionally influenced primarily by men and by hunters. It is, therefore, relevant to ask what would happen if the Model were abandoned.
>
> Almost certainly, wildlife would become, again, the private property of the social elite, as it had been through the ages, and public land would lose much of its value and appeal to the common man. While some game species would flourish, supported by market forces, carnivores would be severely decimated if not exterminated and all migratory birds diminished. Gun ownership in North America would be severely controlled and largely

> eliminated. The freedom to move geographically about "natural landscapes" would be severely restricted, and concentrated, much as it is in Europe. Compared to today, the freedoms and quality of life of all North Americans would be considerably diminished.

Geist and Mahoney then continue their defense of NAM by excoriating what they call "protectionism" in conservation, or the kind of thinking Geist refers to as the "Nature Knows Best" philosophy of those who haven't the stomach to enact the politically incorrect hands-on predator management required to prevent "predator pits" (Mahoney and Geist 2019; p. 17):

> ….the notion that protection of large areas from hunting preserves nature unchanged in perpetuity prevails. However, protectionism is by its nature and definition a deliberately blind, non-management system, tenaciously resistant to corrective action. All biotic changes that do occur are accepted under the notion that "Nature Knows Best." Another example of hands-on management increasing biodiversity can be found in the Deseret Ranches of the Mormon Church. These achievements may be contrasted with circumstances where stunning wildlife populations on public lands placed under protectionism have withered away, turning the landscape into a wildlife desert, as exemplified by the Spatsizi Plateau Provincial Park in northern British Columbia. The cause of this is quite well known: it is that predator protection policies generate a "predator pit." In the meantime, critics grapple with environmental organizations zealously defending irrational, patently false beliefs about nature.

What should be taken away from the above passages? What of Geist and Mahoney's warning that "politically correct" attacks on the NAM might someday lead to its abandonment in a conservation landscape dominated by feminists and "nature protectionists?" Or the claim that, without the model, under the rule of "Nature-Knows-Besters" carnivores might be eradicated and

wildlife in general would belong only to the elites and market force? To many Americans the most alarming claim would be the authors' prediction that abandonment of this 20-year-old conservation model would result in the loss of the nearly 300-year-old Constitutional right to bear arms- not to mention the liberty to visit millions of acres of public wilderness. However, to this author's ears, Geist and Mahoney's claims, and the fear they are seemingly meant to elicit in a quickly greying demographic with dwindling political clout- doesn't warrant more than an incredulous double take before leaving the authors' altogether enlightening defense of their model.

Having heard from the "foremost experts on the NAM" (Mahoney and Geist 2019; p. 1), it is time to turn back to the Biological Survey, now Wildlife Services, and how the agency endorses, and conversely, ignores the NAM's principles for its own ends.

CHAPTER 7

Privileges but No Obligations, Justifying America's Oldest War

The last word in ignorance is the man who says of an animal or plant, "What good is it?" If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering.

-Aldo Leopold, Journals of Aldo Leopold, 1953

The values defined by the seven tenets of the NAM now comprise the foundation for current wildlife conservation policy in Canada and the U.S., and influence wildlife management globally (Organ et al., 2012; Artelle et al., 2018). State wildlife managements and sportsmen's organizations like the Rocky Mountain Elk Foundation and today's Boone and Crockett Club enthusiastically proselytize the NAM as both a guide and a historical explanation of the success of democratized hunting and "consumptive" conservation in the U.S. (Organ et al., 2012; Mahoney and Geist 2019). However, significant challenges have been made to the model's continued success in contemporary times as the hunting population ages and shrinks, while non-consumptive wildlife use and disapproval of mass lethal removal of predators like wolves and coyotes grows (FWS, 2016; Bruskotter et al., 2018).

As well, significant questions as to whether state and federal agencies under WS's aegis that use or tacitly endorse state sponsored elk feeding lots, bounties and canned hunts can still

claim they operate within the purported values of the NAM, or even the loosely defined doctrine of fair chase (Beuchler and Servheen 2008; Nelson et al., 2011; Artelle et al., 2018; Treves et al., 2019). Who Wildlife Services serves appears self-explanatory when one starts looking into the numbers of native wildlife the agency has killed since they started publishing their fatality data in 1996. Below is a sample of six native predator species and WS's "animal damage control" fatality estimates from the last decade.

Table 4.1 USDA Animal Damage Control Estimates 2010-2020 for Six Native Predators

Year	Total Native Fatalities	Cougars	Black Bears	Bobcats	River Otters	Coyotes	Wolves
2010	**3, 540, 052**	**367**	**586**	**1405**	**572**	**80, 639**	**452**
2011	**3, 550, 024**	**402**	**574**	**1263**	**552**	**83, 195**	**365**
2012	**1, 586, 932**	**396**	**567**	**1062**	**533**	**76, 048**	**504**
2013	**2, 041, 616**	**395**	**419**	**866**	**410**	**75, 217**	**320**
2014	**1, 310, 629**	**305**	**580**	**796**	**454**	**61, 640**	**322**
2015	**1, 681, 283**	**284**	**480**	**731**	**492**	**68, 810**	**384**
2016	**1, 589, 439**	**332**	**407**	**997**	**535**	**76, 859**	**415**
2017	**1, 320, 075**	**319**	**552**	**1001**	**675**	**69, 913**	**356**
2018	**1, 496, 775**	**384**	**361**	**1014**	**710**	**68, 186**	**357**
2019	**1, 258, 738**	**308**	**405**	**800**	**613**	**61, 882**	**302**
2020	**433, 192**	**284**	**703**	**703**	**707**	**62, 537**	**381**
10 Year Total	**19, 808, 755**	**3776**	**5634**	**10, 638**	**6253**	**784, 926**	**4158**

By their own accounts, the agency has killed nearly 20 million native animals since only 2010 (USDA APHIS, 1996-2020). However, those are just estimates because it is impossible to know exactly how many animals were poisoned or fatality wounded, or bulldozed in burrows and dens, like prairie dogs, which WS kills by the thousands every year. It's noteworthy that the annual number of coyotes killed, which grew quickly after the federal poisoning campaigns began in earnest in the 1930's, has exceeded 60,000 since 1985 (Berger, 2006; ASM, 2012; Bergstrom et al., 2014; Ripple et al., 2014; Hody and Kays 2018; Hinton et al., 2019). In response to calls for more transparency, since 1996 Wildlife Services has annually published lengthy animal damage control fatality records, but other information- why it killed which species, at whose request, and if any nonlethal efforts were first made- is all largely unavailable to the public (ASM, 2012; Shivik, 2015).

Several scientists, journalists, and environmental groups have tried to drag the agency's activities out into the public's view, but WS has largely withstood these exposés unscathed (Frank, 1924; Leopold, 1944, 1949; Leopold, 1963; Cain et al., 1971; Nelson et al., 2011; Knudson, 2012; ASM, 2012; Peterson and Nelson 2016; Goldfarb, 2016; Artelle et al., 2018; Treves, 2019; Bogezi et al., 2019). Responding to ethical and scientific criticisms, Wildlife Services claims that it is evolving and changing course, and it seems that it has, as agency scientists and officials have spoken at Humane Society conferences, launched new nonlethal research projects, and held workshops on deterrence techniques (Shivik, 2003, 2015). While still advocating for lethal removal and toxicant use in the same document, some of the literature WS published on coyotes in 2020 reads very differently than reports published by the Biological Survey in the early 20th century (USDA APHIS, 2020; p. 6):

> Mated coyote pairs are extremely protective of their territory when raising young and will vigorously defend it from other coyotes. Coyotes often den year after year in the same general location. If a particular denning pair of coyotes has a history of existing with and not preying on livestock, it may be advantageous to leave them alone. Their removal will open up a territory that may become occupied with coyotes that could prey on livestock.

The words "it may be advantageous to leave them alone," while seemingly innocuous, speak volumes between the lines about the changes happening in WS's operational culture. Still, almost 100 years of well-oiled and long funded tradition would make any bureaucracy resistant to reform. Well respected biologists working for WS have been employed to study and design nonlethal techniques since 1972, but the animal body counts, especially of coyotes and large predators, have mostly stayed the same, indicating the science WS's funds seems to be of little relevance to operations in the field (Shivik, 2015; Artelle et al., 2018). For instance, in 2019 WS killed 1,258,738 native animals, and in 2020 killed 433,192 native animals, the lowest since they started keeping public data records (almost certainly due to the Corona virus outbreak). While this represents a substantial decrease in native animals killed, the reports also reveal no significant decrease in 2020, or over the last 10 years, in the fatalities of native predators such as wolves, coyotes, foxes, black bears, and cougars.

In fact, despite even a global pandemic, WS killed more coyotes and wolves in 2020 than they did in 2019. The numbers of predators killed has remained steady over the last decade, as does deaths of federally protected species like river otters (more than half of the hundreds of river otters WS killed every year for the last decade were "accidental"). Just three avian species: cowbirds, red-winged blackbirds, and grackles, alone accounted for ~795,000 fewer native animals killed in 2020 than in 2019 (USDA APHIS, 1996-2020). While WS does conduct useful

animal damage work, keeping airports safe from bird strikes and dealing with invasive species like Burmese pythons, carp, bark beetles and feral hogs, a full quarter of the agency's more than billion-dollar budget goes to protecting livestock (Shivik, 2015).

A disproportionate amount of that budget is dedicated to lethal removal of coyotes, well above other animal damage control efforts, including feral cats and pythons, which are arguably far more destructive ecologically. Dr. John Shivik, a biologist who once worked for Wildlife Services directing research on nonlethal livestock interventions (but quit when he became disillusioned with the agency) believes WS's stubborn refusal to abandon lethal removal stems from their funding mechanisms, whereby "cooperators"- the agency's term for livestock producers who contract with it- share operational costs (Shivik, 2015). For instance, in 2013 cooperators supplied the agency with $80 million, while WS received $85 million in federal funding (Goldfarb, 2016).

Because of the contractual nature of this exchange, WS agents and management officials can often feel pressure to appease their agencies' de facto clients. Sam Sanders, once a Wildlife Services assistant district supervisor from Nevada, gave Ben Goldfarb of High Country News a similar account in 2016. Sanders, who left the agency in 2011, said WS supervisors favored aerial gunning and strafing coyotes in fields, not because it was cost effective, or even as effective as cheaper non-lethal means at reducing lamb losses, but because of its literal extreme visibility to politically powerful local cooperators and landowners (Goldfarb, 2016).

John Shivik has also suggested the best way to reform WS isn't hamstringing them with less federal funding, but doubling their budget, cutting out ag-cooperator contracts and hunting dependence entirely, making the agency fully accountable to average American taxpayers (Shivik, 2015). Shivik's suggestion seems to echo those of the Cain Report, which spoke of the

"gyroscope" of agricultural money that consistently pointed the agency in the wrong direction- the same direction financial incentives of farming of deer and elk point state game managers- toward endless and counterproductive war with predators (Cain et al., 1971). Today if a farmer faces predator losses or even suspects it, an agent will come and kill what ails them, but in most states should a sheep or cattleman want guardian dogs, range riders, electric fences, or motion sensing predator scaring devices, he is almost always on the hook for the cost.

People have compellingly argued that ranchers shouldn't be getting any form of what amounts to a heavily subsidized taxpayer funded "predator pest service," non-lethal or otherwise, as agriculture is already disproportionately subsidized in America. However, keeping ranching and farming operations feasible, especially small-scale multi-generational ones, can have an inherent ecological buffering effect on private land, slowing or preventing development and urban sprawl with the long-term community mentality of "cows not condos." Thus, agricultural interests do not necessarily have to be diametrically opposed to those of wildlife and can even protect wildlife migratory corridors. How applied ecologists someday go about bridging these possible solutions, conflicts, biological realities, and human needs will no doubt come to define the future of American conservation.

Studies of the costly lethal removal of predators and the resulting ecological upheaval that ensues makes these measures both unnecessary and counterproductive to Wildlife Service's own stated goals and the interests of the American public (Frank, 1924; Leopold, 1933; 1944, 1949; Leopold, 1963; Cain et al., 1971; Knowlton et al., 1999; Gese, 2005; Nelson et al., 2011; King et al., 2015; Treves et al., 2019) A major study in 2011 led 23 prominent ecologists to conclude that loss of apex predators was a major driver of destabilization and collapse of their native ecosystems, leading to zoonotic pandemics, irruptions of rodents and harmful invasive

species, increased human-wildlife conflict, and loss of ecosystem services to people (Estes et al., 2011). The events of 2020 seem to have borne many of those observations out.

Another investigation by Berstrom et al., in 2014 found that major roadblocks to better human-wildlife conflict amelioration and restoration of ecological systems were stymied by political ideology that justified persecution of predators to appeal to rural and agricultural constituents (Bergstrom et al., 2014). Ripple et al., also concluded in 2014 that saving and restoring large predators could help stave off further ecosystem collapse and restore ecosystem services (Ripple et al., 2014). Despite being extremely politically contentious, some researchers believe the restoration of wolves to YellowStone has increased certain plants like aspen, cottonwood, and willows, as well as having positive effects on species like beavers and songbirds (Ripple et al., 2014). Additionally, wolf watching based ecotourism brings in millions of dollars to the local economies around YellowStone every year (Ripple and Beschta 2012; Mech, 2017). A diverse body of other research has shown that removal of predators often has more deleterious effects than benefits to people or game animals:

- Removal of apex carnivores can cause irruptions of rodent and ungulate populations (Crooks and Soulé 1999).
- Lethal control of the Australian dingo (*Canis lupus dingo*) has caused similar trophic shifts, resulting in dominance of introduced mesopredators (feral cats/foxes) and herbivores (rabbits), which then cause damage to native plant and animal communities. The lack of dingoes also causes desertification via widespread overgrazing by kangaroos (Wallach et al., 2010; Letnic and Crowther 2020; Legge et al., 2017).
- The mesopredators release theory is exemplified by the recent colonization of southeastern N. America by coyotes following extirpation of wolves, and the overabundance of white tail deer, which are thought to be related to sharp increases of Lyme disease in the U.S (Bekoff, 1995; Levi et al., 2012; Ostfeld et al., 2018; Bragina et al., 2019).
- Local-scale removal of predators has been found to cause rodent population irruptions and reduced diversity in those rodent communities which also increases human infection rates of Lyme disease (Ostfeld et al., 2018).

As for the proposed benefits to native life from lethal removal, WS has unintentionally killed 150 species of vertebrates since 2000 (Knudson, 2012) and at least 12 taxa of mammals protected by the ESA since 1990 (Bergstrom et al., 2014). For example, every year WS intentionally kills more than 100 river otters despite their being protected under the ESA as a threatened species but has also “unintentionally” killed hundreds more than that every year for the last decade (USDA APHIS, 1996-2020). For nearly 100 years the American Society of Mammalogists (ASM) has critiqued this kind of lethal control of native wildlife, particularly carnivores, by the United States federal government, starting in 1924 with its first ever published Society resolution (Jackson, 1924).

In 1999, the AMS passed another official resolution at their annual meeting calling on Wildlife Services "to cease indiscriminate, pre-emptive lethal control programs on federal, state and private lands" (ASM 1999; p. 1). The ASM then published another resolution in 2012, reiterating its opposition to random lethal removal (ASM 2012; p.1):

> Ecosystem science has progressed a great deal since Leopold’s 1949 essay and has only bolstered his epiphany on the integral value of intact ecosystems with their apex predators, and the pervasive ecological damage done by removing them from natural systems (Estes et al., 2011). WS’s ongoing record of lethal control stands in stark contrast to this growing consensus among ecologists...The number killed per year of many of the primary targets of WS lethal control and of certain other carnivores is remarkably constant...The consistency of these numbers, year after year, implies either that the killing is creating population sinks that quickly fill, or that reproduction is compensating for the increased mortality.

> However, we have no real data on the effects of this lethal control on the populations of target or non-target species because there is very little monitoring being done. Nevertheless, it is clear that the ongoing slaughter has not brought about any long-term solution to the perceived problem; instead, **it is estimated that at least 5 taxpayer dollars are expended to kill every coyote that is deemed responsible for the loss of one dollar's worth of livestock**, and this figure does not count the damage to the range and lost forage for the livestock caused by any compensatory increases in jackrabbits when coyotes are removed (ASM, 2012).

Despite a growing chorus of scientific criticism, WS continues to use toxicants, bounties, and traps to attempt to increase "game" numbers by killing native predators, regardless of a wealth of research that does not support this paradigm of "management":

- A study by Bragina et al., studied the effects of coyote predation on deer populations from 1981 to 2014 in 384 counties of 6 eastern states in the United States with linear mixed models. Overall, deer populations in all states experienced positive population growth following coyote arrival (Bragina et al., 2019).
- In Europe, restoring the Eurasian lynx (*Lynx lynx*) facilitated greater human hunting success for roe deer (*Capreolus capreolus*) (Gehr et al., 2018).
- Experiments removing cougars and coyotes in Idaho showed drought and weather-related mortality (called "winter-kill") to be much more important than predation in predicting population declines of mule deer (Bergstrom, 2017).
- Predators lower rates of disease in prey populations via the Hygienic Effect (Ripple et al., 2014). Pumas have been shown to preferentially prey on Chronic Wasting Disease infected cervids (Krumm et al., 2010), improving herd health overall.
- Studies from Idaho showed habitat quality to be crucial to mule deer fawn retention, rather than limiting coyote predation (Hurley et al., 2011). Furthermore, the generally poor condition of several rangelands in the United States can be attributed partly to overly abundant ungulates (Leopold, 1943; Beschta and Ripple 2010; Bragina et al., 2019).
- A study documenting a 7-year long effort to remove all mammal predators of ground-nesting birds (including coyotes) from study sites in the southeastern United States concluded that removal of mammalian predators had no overall effect on preventing nest

predation, primarily because of compensatory predation by snakes (Ellis-Felege et al., 2012).

- An even bigger study, a meta-analysis of 113 predator-removal experiments (of a taxonomically diverse sample of predators and prey) found that the intended beneficiary prey populations declined in 54 cases after predators were removed (Sih et al., 1985; ASM, 2012).

As for the proposed benefits of random lethal removal of predators to livestock producers, studies of methods like poisoning, snaring and bounty programs efficacy in preventing conflicts and livestock losses are negligible (Crabtree and Sheldon 1999; Gese, 2005; Peebles et al., 2013; Shivik, 2015):

- The United States Department of Agriculture stated in 2015 that less than 1 percent of cattle and sheep, including calves and lambs, were killed by predators such as pumas, coyotes, foxes, wolves, and birds. The most common causes of loss for producers are disease, calving problems (still births), and weather (USDA, 2009).
- Recreational hunting of Eurasian lynx (*Lynx lynx*) in Europe was found to have little effect on sheep depredation unless of a magnitude to cause lynx population decline (Herfindal et al., 2005).
- When non-offending resident coyotes are killed, social structures and territorial defenses are disrupted, allowing young, transient coyotes (that were formerly excluded) access to livestock. Non-offending, mated pairs of coyotes can prevent livestock losses by defending a territory as "guard coyotes" (Jaeger et al., 2004)
- Use of public harvest of cougars in Washington state to attempt to remediate livestock depredation was found to be ineffective (Peebles et al., 2013).
- Lethal control of gray wolves in the northern Rocky Mountains, causing total mortality of up to 25 percent of the estimated population, was found to actually increase depredation on livestock because culling had negatively affected pack hunting structure, stability and ultimately their ability to consistently take large prey (Wielgus and Peebles 2014).
- Use of nonlethal methods in South Africa, such as guardian dogs and livestock protection collars, were more effective in preventing livestock depredation by leopards (*Panthera pardus*), caracals (*Caracal caracal*), and jackals (*Canis mesomelas*), as well as less expensive than lethal predator control (McManus et al., 2015).
- Stone et al., found in a 7-year study of wolf habitat in Idaho, that the use of a suite of nonlethal deterrents reduced sheep depredation by more than a 3-fold margin when compared to sheep producers in Idaho that used lethal control over the same time period (Stone et al., 2017).

Predation studies by a wide array of researchers suggests that even "moderate" random predator removal can potentially increase densities of coyotes, because nontarget deaths of co-occurring carnivore species (bobcats, etc.) temporarily decreases food competition (Casanovas et al., 2012). There are four overarching reasons that exploitive coyote removal is likely to have no long-term positive effect:

- Immigration rates into the area experiencing lethal control often increase after stable resident pairs and their offspring are removed (Sacks et al., 1999).
- Vacant territories are quickly recolonized, by potentially multiple breeding transient pairs (Knowlton et al., 1999; Gese, 2005; Bekoff, 1995).
- Transient immigrant coyotes are more likely to be subadults, which have a greater propensity for risky behavior like livestock depredation than more experienced, local older adults (Peebles et al., 2013).
- Under constant high rates of exploitation, coyotes may respond by having larger litters. Because at least 70 percent of a given population must be removed annually to suppress their recolonization, current bounty and removal methods are counterproductive (Crabtree and Sheldon 1999; Gese, 2005; Shivik, 2015).

In open range or deserts where the implementation of nonlethal strategies like dogs and electric fences may not be feasible or cost effective, Wallach et al., have argued that simply ending lethal control of large predators can be more effective, and based these findings on studies of dingoes in Australia. Wallach observed reduced sheep depredation after ending poisoned baiting allowed the social structure of the dingoes (and their kangaroo hunting efficacy as a pack) to stabilize (Wallach et al., 2009; ASM, 2012).

All the above-mentioned studies suggest that tolerating self-regulated populations of predators by simply allowing their natural social structures to exist both reduces livestock depredation and restores ecosystem functions. What is also apparent is that the current system of management methods endorsed by WS on the state and federal levels *are* insufficient at improving ecosystem services or reducing human-wildlife conflicts, and do not represent the

values and beliefs of a far larger segment of American society than they currently serve (ASM, 2012; Artelle et al., 2018; Bruskotter et al., 2018; Treves et al., 2019).

To be fair, the total number of animals WS has culled each year has generally fallen since the mid 2000's, be it due to decreases in funding, more effective methods, or an organizational response to a growing public image problem. Additionally, the number of coyotes killed in America by WS (60 K annually since 1985) is miniscule when compared to how many coyotes the hunting public takes annually, approximately ~500 K individuals a year (Shivik, 2015; Hody and Kays 2018; Hinton et al., 2019). Increasingly sophisticated gear like electronic callers, night vision scopes, and little to no regulations about when and how they can be hunted (at night, from vehicles, with spotlights, without seasons), has all resulted in coyote sport hunting growing in popularity. However, the spread of a far more controversial niche form of hunting is also gaining in popularity, the wildlife killing contest.

Wildlife killing contests (WKCs) are multiple team events that take place over several days, during which several targeted native species, most commonly coyotes, but also bobcats, raccoons, wolves, crows, rays, prairie dogs, rattlesnakes, foxes, and sharks are killed in unlimited numbers. Prizes like AR-15s, cash pots, and sponsorships are won by teams turning in the largest, smallest, or highest number of a given species. WKCs are legal in more than 40 states, on public and private land. One such contest, the West Texas Big Bobcat Contest, one of more than 600 in Texas alone, pays out $50,000 dollars for the biggest bobcat carcass. One of the largest of these killing contests in the southeast is the Eastern U.S. Predator Calling Championship, a 2-day event spanning states east of the Mississippi river. From the contest's website (EUSPCC, 2021):

> Predation on livestock, wild game and pets is a growing problem throughout many communities and predator hunting helps to reduce this problem. The EUSPCC includes predator hunters from all across the country helping to control the predation problem in 26 states east of the Mississippi River.

Of course, there is no more a national "predator problem" today than there was in 1897, and random mass killing of wild animals is an anachronism that has no place in modern wildlife management. Decades of science, much of it published by divisions of WS agencies themselves, confirms this (Conner et al., 1998; Crabtree and Sheldon 1999; Crooks and Soulé 1999; Gese, 2005; Shivik, 2015). V. Geist, the forefather of the NAM (and who has been called a wolf hater more than once over the years), when asked about WKCs by Todd Wilkinson of *Mountain Journal* said, "The brutal killing of wildlife for entertainment or self-aggrandizing is pathetic, as is virtually every attempt of self-aggrandizing" (Wilkinson, 2018).

In the two days the EUSPCC contest took place in 2020, over 200 teams removed hundreds of coyotes, foxes, raccoons, and bobcats from the landscape of 26 states, totaling 848 individuals counted. Because the pelts of these animals have little monetary value close to spring, the majority of the carcasses are simply disposed of after these competitions, and the contest's website sternly warns participants about consequences for dumping dead wildlife illegally or where they could be seen. The language from their own social media (below) speaks for itself, and it seems the people organizing these contests want them kept below the radar of the average, nonhunter citizen (EUSPCC, 2021):

> -All coyotes/fox must be covered or out of sight after all hunting is concluded and your team is on the way to check-in. If you use a rack, a tarp or plastic cover will work. If you are using a truck, all coyotes must be below the bed line of the truck and not visible to other motorists.

> -All coyotes must be disposed of in a proper manner by your team. Please don't dump coyotes in an illegal manner if you want this event to continue in the future. We WILL work with game officials if an illegal dumping incident occurs.

People of course have illegally dumped large amounts of dead wildlife after these contests, which have occasionally been reported to the news. Such a discovery occurred near a residential neighborhood in North Carolina in 2019 when a local teenager stumbled upon a WKC dumping site. However, despite residents being horrified by the pile of 70 dead animals left near their homes, North Carolina Wildlife Enforcement officer Samson Parker assured them and the local tv new station that all was in order- it was fully legal to kill that many coyotes and that: “It looks like one individual got a hold of all these coyotes and unfortunately just made a bad decision to dispose of them not properly” (WBTV, 2019). Eventually the individual who dumped them was found and ticketed for littering.

The old persistent narrative that killing native predators helps farmers and ecosystems is fed to the hunting public by state-federal game managers indirectly and directly, via state sponsored bounties or state sanctioned killing contests like the Eastern U.S. Predator Calling Contest. The Department of Natural Resources of South Carolina has made a particularly morbid game of state sponsored wildlife bounties, and captures 16 live coyotes a year, then tags and releases them. Anyone turning in a tagged carcass gets a lifetime hunting license (SCDNR, 2019). Bounties and WKCs, which almost never utilize any part of the animals taken, are a blatant wanton waste.

Figure 4.1 (Above) A trailer loaded with coyotes. Eastern U.S. Predator Calling Championship in Wytheville, Virginia on January 19, 2020. Image credited to Wolf Patrol, 2020.

Figure 5.1 (Below) Truck bed filled with fox. Eastern U.S. Predator Calling Championship in Wytheville, Virginia on January 19, 2020. Image credited to Wolf Patrol, 2020.

Like so many unscientifically founded wildlife management practices, money appears to be the main driver for the spread of these contests. Besides WS's financial reasoning for supporting WKCs because they sell hunting licenses and "increase game," sporting goods stores,

gun makers, and hunting gear companies all have their own financial incentives to support WKCs with cash and prizes like AR-15s, often donated by gun stores. Once found mostly in western states like Idaho and Wyoming, these contests have spread quickly, popularized through advertisements and forums on social media. Because so few laws regulate the hunting of coyotes and other "vermin" wildlife species like foxes, they are exceptionally vulnerable to unethical harvesting practices, most not in keeping with any reasonable interpretation of the NAM.

Under this paradigm coyotes are currently afforded so little welfare protection that it is legal to kill them in almost literally any fashion, even running them over with vehicles. Presumably, many Americans would be appalled to learn that in 2021, it is perfectly legal to chase coyotes and wolves in Wyoming and Idaho for miles until dispatching them by running them over with ATVs, cars, or snowmobiles. Doing this to elk, sheep, cows, or deer would land you in a jail cell with thousands in fines and could permanently cost you your hunting license. Under current WY law wolves and coyotes in 4/5ths of the state can be taken, "with, from, *or by use of* any aircraft, boat, automotive vehicle, trailer, 35 motor-propelled wheeled vehicles or vehicle designed for travel over snow," (WDNR 2019; p. 9). House Bill 288, a bill to make intentionally running over wildlife with a vehicle illegal, was introduced in the spring of 2019 by Representative Mike Yin *(D-Jackson*), but died when it was signed onto by only one other Wyoming lawmaker.

As we heard earlier, Governor Little of Idaho has taken Wyoming's lead and greenlighted this kind of unethical harvest of wolves and coyotes into law with Bill SB1211 in 2021. Unlike Idaho's wolves, none of this increasingly extreme persecution will reverse the coyote's population expansion, and in all likelihood, like the moral punchline of some very long Aesop's fable, is instead increasing coyote numbers and conflicts with people (Gese, 2005;

Bekoff, 1995; Shivik, 2015; Treves et al., 2019). WS has known about this for a long time, as a seven-yearlong study of *C. latrans* management published out of the USDA's own Wildlife Service research center as far back as 2005, by Eric Gese, found that random coyote culling does not facilitate effective population management of the species, as have a perilously tall stack of studies since then (Conner et al., 1998; Gese, 2005; Bekoff, 1995; Crabtree and Sheldon 1999; Crooks and Soulé 1999; Wallach et al., 2010; Shivik, 2015; Artelle et al., 2018).

Wildlife killing contests may be the very worst and extreme examples of WS and the NAM's ethical and operational failings. However, things are changing, in these agencies and in the minds of the public. As in past times in America, growing numbers of people are starting to notice that all is not well. Today, groups like the Center for Biological Diversity and Project Coyote are demanding, often in courts, that their governments respond, and they are starting to do so. Since 2014 seven states have passed bans of WKCs: California was the first in 2014, followed by Vermont and New Mexico. Arizona and Massachusetts then passed bans in 2019, and Colorado and Washington did the same in 2020. Nevada and New York are both poised to pass their own WKC bans in 2021, and grassroots movements are gaining momentum in Maryland. As the indefatigable Margaret Mead quote goes, "Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has" (Mead and Textor 2005; p. 12).

Regardless of resistance to changing WS's operational culture, the looming issue of a wildlife management paradigm whose funding depends so heavily on a quickly aging and shrinking hunting demographic will someday force the issue of change. However, plans must be made now to generate a greater amount of conservation funding revenue on state and federal levels from the so-called "non-consumptive" public that benefits from access to hiking,

kayaking, and bird watching on millions of acres of public land (George et al., 2016). Some of that change is already underway, as the language and practice of game management slowly evolves, and steadily grows farther away from its Utilitarian roots in a colonialist past, as Aldo Leopold seemed to think it would (Leopold, 1933; Gese, 2005; Wallach et al., 2017; Legge et al., 2020).

CHAPTER 8

The Anthropocene or the Age of *Galus galus domesticus*?

Like winds and sunsets, wild things were taken for granted until progress began to do away with them. Now we face the question whether a still higher 'standard of living' is worth its cost in things natural, wild and free. For us of the minority, the opportunity to see geese is more important than television.

-Aldo Leopold, A Sand County Almanac, 1949

Our long and winding investigation has answered two of our original big questions- why was the coyote so uniquely evolutionarily primed to exploit humans, and if their management had anything to do with their explosive repopulation. The answers are all bound up in coyote evolution as a perpetually unkillable underdog, and the Biological Surveys (now Wildlife Services) equally undying refusal to abandon it's 100-year-old lethal *modus operandi*, which, it turns out, is a perfect machine for turning tax money into poison and bullets and turning that into exponentially more coyotes.

It appears that the ethical cloak of the NAM's orientation to the democratization of hunting may still partially justify the asymmetrical management of elk and coyotes for Roosevelt's continued dream of "game," despite being an increasingly questionable and financially untenable conservation paradigm (Peterson and Nelson 2016; Artelle et al., 2018). However, the justifications for the most extreme arms of WS's killing machinery- the bounties, the mass poisonings, the aerial gunning, and the wildlife killing contests, explicitly do not

compute with Leopold's proscriptions for science based and ethical management (Leopold, 1949; Cain et al., 1971; Nelson et al., 2011; Nelson and Treves et al., 2016; Artelle et al., 2018; Treves et al., 2019).

Having addressed that part of our investigation, our inquiry now brings us to a contemporary time when the coyote's strange story has become more intertwined with humans than ever before, the Anthropocene, and our final and maybe most important question. Can these canid super survivors improve biodiversity when it is otherwise withering in what a growing number of scientists are declaring is a 6th mass extinction event (Ceballos et al., 2017)? To understand how beneficial the coyote's return could be for biodiversity in this new human dominated age, we will cast our inquiry briefly outside the bounds of N. America, because human domination of the planet has come to define this new epoch.

In the last century, the human population has grown dramatically, as has humanity's impact on the natural world. At the beginning of the 1900's there were some 1.6 billion people on Earth, in 1950 around 2.5 billion, by the year 2000 that number had grown to 6.1 billion, then 7 billion by 2010. Those estimates are expected to increase to 9.8 billion by 2050 and may peak in the year 2100 at 11 billion (United Nations, 2009). Today humans and their domesticated livestock account for an estimated 96 percent of all mammal biomass, all other wild mammals, such as elephants, skunks, and mice, represent only 4.2 percent of mammal biomass (Bar-Ona et al., 2018; Vaclav, 2011). Mammals overall (including humans and domesticates) comprise an even smaller fraction of all biomass on Earth, around 0.03 percent total, the rest primarily being made up of plants and bacteria, which account for most of life on land and sea. That humans and their domesticates, species like cows and chickens, make up such a large portion of life on earth,

speaks to what some geologists and biologists have coined the “Anthropocene,” or the age of man (Adams, 2020).

When this proposed new geologic era of human domination began is still debated, some think it was ushered in by the Agricultural Revolution over ten thousand years ago (Waldman, 2017), while others point to Industrial Revolutions in the late 1700s (Abram et al., 2016). However, some scientists make a compelling case for drawing the Anthropocene line a little later, occurring at exactly 5:29 a.m. on July 16th, 1945, during the detonation of the first atomic bomb, when humans claimed the dubious distinction of being the only known species to intentionally invent its own potential annihilation (Sepkoski, 2021). Regardless of when and where that ultimately arbitrary demarcation is recorded by geologists, it is clear that since walking out of Africa, humans have ecologically reordered nearly every corner of the planet and continue to dominate life on Earth.

A 2011 biomass census conducted by Vaclav Smil concluded that human activity since roughly five Kya has eliminated some 50 percent of the Earth’s biomass (Vaclav, 2011), including 178 species of the world’s largest land mammals. Animals in the ocean have not fared any better. Despite faster ships, more nets, and better technology, the global catch has been going down since 1992, and species like rays and sharks are in free fall (Vaclav, 2011: Bar-Ona et al., 2018). Equally alarming is the loss of nearly half of the Earth’s forests since the Pleistocene, which have been reduced from six billion hectares to almost three billion hectares. According to the Global Forest Resources Assessment of 2010 (GFRA, 2010; Ritters et al., 2016) much of the remaining forests are degraded or fragmented, and around 13 million hectares a year continues to be lost to slash and burn agriculture and logging.

In contrast, since the 1990's the number of domesticated chickens (*Galus galus domesticus*) has exploded to over 23.7 billion birds on any given day and accounts for more than twice the total biomass of *all* wild birds (Carys et al., 2018). It is estimated that humans eat over 65 billion chickens annually, and because of this several authors have proposed instead of declaring an age of man, it might well be the geologic age of the broiler chicken, as there are many times more chickens on earth than humans. In terms of biomass, the thunderous, sky-blackening flocks of *E. migratorius* that once awed Audubon in 1813 have effectively been replaced many times over by chicken sandwiches and hot wings (Audubon, 1835). As a result, trillions of *Galus galus domesticus* bones are deposited into landfill strata every year, and one can only imagine what some future archaeologist or paleontologist will make of the mountains of chicken bones and plastic we leave them.

Wildlife must adapt to anthropogenic realities like climate change and development or perish as a part of the deluge of extinctions, some 1000 times the "normal" background extinction rate, happening now. When these factors force animals to migrate or adapt, behaviorally novel combinations of predator and prey unfold, especially on the fringes between green spaces and developed areas. The lines once drawn between animal populations that put them into seemingly binary biological categories, native and invasive or natural and unnatural behavior, continue to blur in an increasingly human world whose ecosystems are being reordered in unknown and unpredictable ways. Some species, like coyotes, whitetail deer, howler monkeys, and carp, also sometimes called weed species, excel at exploiting disrupted landscapes, and are taking their places in new anthropogenic ecological contexts as major players in food webs. Many other animals are struggling just to make a living, such as the polar bear (*Ursus*

*maritimu*s). But in other parts of the world some predators, like the coyote, are also adapting to survive and can offer us hope for the wild in this new age.

CHAPTER 9

Landscapes of Fear and Biodiversity

He was a killer, a thing that preyed, living on the things that lived, unaided, alone, by virtue of his own strength and prowess, surviving triumphantly in a hostile environment where only the strong survive.

-Jack London, Call of the Wild, 1903

Unlike living relics such as the polar bear, smaller, more flexible predators besides coyotes are surviving the Anthropocene by learning to make an urban living, adapting in exceptionally novel ways, such as Indian leopards (*Panthera pardus*), which have lost nearly half of their former ranges in the last 50 years. To survive these cats have had to adapt to living close to people and their cities, and they are having outsized ecological effects in and near these cities (Ripple, 2014). One such city is the sprawling Indian urban center of Mumbai, home to more than 18 million people, as well as the hunting grounds for roughly 40 leopards. The leopards are presumed to live in the surrounding Sanjay Gandhi National Park, which is situated at the very edge of the city and home to the densest known population of leopards anywhere in the world. While not all of the park leopards venture into the city, the boldest stalk rooftops and alleys late at night to hunt for street dogs, of which there are over 95,000 in Mumbai alone.

Based on carcasses and leopard scat Braczkowski et al. (2018) estimate that feral dogs may comprise some 40 percent of their diets, and that local leopards may be taking as many as 1500 dogs a year. While the number of leopards hunting dogs is too small to have much impact

on their overall numbers, the study found that dog populations in the villages surrounding the perimeter of the park were 17 dogs per square kilometer, compared to 680 dogs per square kilometer in the heart of the city. This means the fearsome presence of leopards has kept most of the street dogs out of and away from the neighboring forest reserves, sparing endangered native wildlife in the reserve from dog depredation.

The chilling effect predators have on prey behavior is increasingly referred to by biologists as a paradigm called “the landscape of fear.” Essentially, predators not only reduce numbers of their prey but heavily impact their behavior, limiting overgrazing or overexploitation of smaller prey species (Gaynor et al., 2019). As a new apex predator coyotes in urban and suburban centers also appear to be imposing a “landscape of fear” on another human domesticate that is wreaking havoc on wildlife, feral or free-roaming domestic cats (*Felis catus*). Predation on domestic animals, especially free roaming pets or strays, is one of the primary issues that make urban and suburban coyotes controversial. However, in reality, it is our own domesticates themselves that pose a much greater threat to both wildlife and people than coyotes ever have.

Nearly 90 million dogs live in the U.S and every year 4.5 million people are bitten by dogs, with some 800,000 seeking medical attention and 30-50 (nearly all children) humans are killed in dog attacks (Maniscalco et al., 2019). In contrast, only about a few dozen substantiated attacks (almost all by rabid individuals) and a total of three human deaths have been attributed to coyotes in the last 200 years (Baker and Timm 2017). Our other favorite domesticated predator, *Felis catus*, poses little threat to people, but is truly a menace to wildlife and is thought to have contributed to the extinctions of at least 33 species across the world, mostly birds and small mammals (Osland et al., 2013). Globally, it is estimated that domestic cats kill 1.3-4.0 billion birds and 6.3-22.3 billion mammals each year, while in the U.S alone cats are estimated to take

hundreds of millions of native birds a year (Banks, 1979; Dauphiné, 2009; Loss et al., 2013; Nogales et al., 2013).

Figure 6.1 A feral cat with an American robin. Plate from Forbush, 1916. Image credited to Library of Congress.

Research published in the journal Science from the Cornell Ornithology Lab in 2019 indicates that native bird populations in N. America have plummeted by more than 300 billion in the last 50 years, representing the disappearance of some one in four birds (Rosenberg et al., 2019). Domestic cats are devastatingly effective predators with high rates of reproduction (there are perhaps as many as 70 million in the U.S alone), both these factors, coupled with human tolerance of ubiquitous free-roaming cats, is a recipe with disastrous consequences for native wildlife. While feral cat catch-spay-release programs make small dents in their numbers in some cities, it is perhaps an urban predator, like the leopards of Mumbai, that may be most useful in limiting cat predation of small native mammals and birds.

Several studies of urban cat/coyote ecologies, in cities such as Chicago, in which both feral cats and coyotes were trapped and fitted with GPS satellite collars to monitor their spatial habits and rates of sympatry, indicate streetwise cats avoid spaces patrolled by coyotes (Grubbs,

2009; Gehrt et al., 2013; Kays et al., 2015; Kays et al., 2020). The cat's fear of coyotes results in partitioned cat and coyote ranges, with cats often sticking closer to homes and businesses (people), while coyotes tend to avoid people by favoring parks, densely wooded lots, golf courses, and cemeteries (Gehrt et al., 2013; Wurth et al., 2020). Conversely, some researchers in Atlanta have reported filming coyotes and cats adopting what amounts to temporary truces, eating out of the same pet food bowls left out on porches, indicating that these sympatric ecologies are likely to be shaped by hunting habits of individual coyotes and the availability or lack of local food resources (Christopher Mowry, 2021, personal conversation). Regardless, even well-fed outdoor cats are still a greater threat to native fauna than wild coyotes.

Thus, in contrast to the never-ending coyote vs. bird plot portrayed in cartoons, it seems more likely that resident urban coyotes offer at least some protective effect from cats for wild birds and small mammals in the green spaces they patrol (Soulé, 1988; Gehrt et al., 2013). Indeed, though coyotes will opportunistically snatch a bird or turtle egg when presented with the chance, overall, they decrease predation pressures on ground nesting egg layers by keeping cats, rodents, and the numbers of native omnivores like possums, skunks, and raccoons in check and on the move (Crooks and Soulé 1999; Ellis-Felege et al., 2012; Gehrt et al., 2013; Kays et al., 2015; Kays et al., 2020).

Urban predators can offer humans more tangible and immediate ecological values, such as the control of rats and mice, which spread diseases to people like the Hantavirus and Lyme disease. Lyme disease is now the most common vector borne disease in the U.S and is linked to overly abundant rodent and white tail deer populations. Since the 1950's human infection rates of Lyme disease have steadily increased, and today some 300,000 people are infected a year in the U.S. (Ostfeld, 2018). According to Richard Ostfeld, a disease ecologist at the Cary Institute

of Ecosystem Studies, there are three major factors contributing to current high infection rates of Lyme disease; habitat fragmentation, lack of predators, and what he calls the Compromised Dilution Effect (Ostfeld et al., 2018; p. 1570):

Table 5.1 Causes of High Rates of Human Lyme disease Infection

(1) Habitat fragmentation: When forested areas are developed and split into patches smaller than five acres the rates of transmission of the spirochete, *Borrelia burgdorferi* (the microscopic parasite that causes Lyme disease) rise dramatically. The transmission from mice to ticks to humans is much greater because these areas have denser populations of white-footed mice due to fewer larger competitors for food like rabbits, gray squirrels, and chipmunks (Ostfeld et al., 2018).
(2) Too few predators: Predators play a critical role in controlling rodent populations and maintaining biodiversity, which is ultimately beneficial to human health. When greenspace is carved into small parcels, this limits the number and variety of predators preying on mice (or deer) within a geographic area, increasing transmission of Lyme disease to people (Ostfeld et al., 2018). Coyotes may play an outsized role in suppressing Lyme disease in fragmented habitats around people by preying on rodents and white tail deer fawns because coyotes can thrive where other predators, such as bobcats, may not (Ostfeld et al., 2018).
(3) Dilution Effect: In several parts of the United States, white-footed mice are the most numerous mammal vertebrates. Weather, predation, food supply, and competition with other mast and seed eating animals directly dictate their abundance. The confluence of those biological factors control, or "dilute" numbers of infected mice and the rates of Lyme disease transmitted to people in a given area. Because biological complexity (number of species) in

ecosystems fosters stability, predators often play outsized beneficial roles in these trophic systems and can offer equally outsized benefits to biodiversity and people. (Ripple et al., 2014; Ostfeld et al., 2018).

To answer our final question, it seems that coyotes (and other native predators) can and do play important regulatory roles in local ecosystems, decrease zoonotic disease transmission to people, and facilitate greater biodiversity, especially in urban and suburban areas (Sovada et al.,1995; Rogers and Caro, 1998; Crooks and Soulé 1999; Henke and Bryant, 1999). Considering that only 14 percent of terrestrial Carnivora species can be found in urban areas today (Iossa et al., 2010), the successes of the coyote, if we can learn to accept and embrace it, may present a unique biological opportunity. Going further than just tolerance, providing these little wolves a place in our cities with green corridors or refuge spaces (comprised of at least five acres) could not only decrease potential human conflicts with city dwelling coyotes and transmission of Lyme disease to people (which is a growing problem in the southeast), but immediately increase urban biodiversity overall. Green spaces where coyotes can suppress rodents, avoid humans, and keep cats out might be particularly beneficial spaces for birds and small mammals, serving as a kind of urban oases for wildlife (Hilty et al., 2019).

Sadly, the true value and complex contributions to ecological systems offered by large and small predators all over the world are just now beginning to be appreciated, as whole orders of carnivores languish under the threat of extinction. An extensive 2014 study by William Ripple (Ripple, 2014) of Oregon University describes the irreplaceable services of predators, including the classic textbook case of California sea otters, who control numbers of sea urchins, which in turn prevents sea urchins from decimating kelp forests that support whole systems of life. Such

studies have focused on keystone species (a species with outsized ecosystem impacts), how one species' presence or absence can fundamentally alter ecosystems. Keystone species are a paradigm which have been researched and discussed in circles of ecology since Robert Paine first coined the idea in the 1960s, after his now famous Californian starfish tide pool experiments (Paine, 1966).

Paine simply removed all the starfish from several tidepools, by chucking them out to sea every morning for months and monitored the changes. Without predation by starfish, mussels took over life in the tide pools and consumed nearly everything else. Some 50 years later the importance of predators now seems obvious to most students of ecology, but continued research is further illuminating how complex predator-prey dynamics not only control the numbers of prey species populations but also indelibly shape entire landscapes, water quality, nitrogen cycles, carbon capture, and plant biodiversity (Ripple et al., 2014). The impacts of predators and the fear they instill in prey, from bats to tigers to coyotes, have long-reaching trophic implications for entire ecosystems and humanity.

To illustrate this paradigm, we should mention a 2013 publication by Michael Strickland of Yale University's School of Forestry and Ecology, who published a study on predators and prey of a smaller variety, nursery web spiders and grasshoppers (Strickland et al., 2013). He conducted an experiment in which he placed several grasshoppers and a spider in an enclosed mesh cage, as well as grasshoppers in spider-free cages in a meadow. He then observed the differences in the feeding and reproductive behavior of the grasshoppers. Not only did the grasshoppers change their behavior in response to the spiders, becoming wary, hiding, and feeding for shorter bursts and on less preferred plants but the spiders also had downstream effects on grasshopper reproduction, decreasing the number and body size of the grasshopper's

offspring and their impact on the enclosed ecosystems. Even spiders with their mouths glued shut had the same effect, just their presence in the habitat was enough.

The spiders eventually reshaped their tiny worlds completely, resulting in a greater variety of plants that were healthier and more robust, with longer root systems and broader leaves, whereas enclosures without spiders were stunted, overgrazed, and contained fewer species of plants. Dr. Strickland theorizes that predators, great and small, might change entire terrestrial carbon cycles by improving carbon fixation in plants, which can dedicate more energy to photosynthesis and growth when herbivores around them are continuously preyed upon and kept moving. He proposes that up to 40 percent more carbon is trapped in plant biomass in ecosystems with intact predator guilds, primarily because of greater carbon storage in grasses and below-ground root structures. If a single nursery web spider can have this big an impact on its habitat, what about the return of a predator the size of a coyote?

Perhaps there is no better answer to the question than a study out of Australia just published in 2021, concerning that continent's own hyper-controversial canid, the dingo (*Canis lupus dingo*) (Fisher et al., 2021). In the late 1880's sheep ranchers erected a 5600-kilometer-long fence, one of the longest manmade structures on earth, which spans across parts of Queensland, NSW, and South Australia to keep dingoes out. The Dingo Fence is so large it can be seen from space. Another thing about the Fence that can be seen from space? Which side has dingoes and which side they have been eradicated from with poison baiting (Fisher et al., 2021). The study of that difference integrated 32 years' worth of satellite imagery provided by NASA and the USGS, augmented with decades of site-based dingo field research on both sides of the Fence. The combination of data allowed researchers to effectively compare the vegetation health

of both sides of the fence, and the results were so striking they were visible to the naked eye from satellite images.

Kangaroos were far more numerous on the poison baited side of the research areas, 3245 kangaroos to just one single dingo, whereas on the opposite side of the fence 85 dingoes and only eight kangaroos were counted at two observation sites (Fisher et al., 2021). Where dingoes were rare, overgrazing by large mobs of kangaroos had destroyed vegetation cover and reduced soil health. Because it rains so infrequently in much of the outback, when it does, overgrazing by kangaroos significantly increases desertification and soil erosion. The contrast in ecology on either side of the Dingo Fence brings to mind the overgrazing and prey species irruptions seen in the U.S. where predators were extirpated in the early twentieth century (Leopold, 1944, 1949).

Australia is in many ways a sort of colonial mirror of America, as an enormous, defiantly wild landscape. Like Old-old-coyote tricksters in indigenous N. American oral traditions, the dingo features prominently in the Dreamtime stories of the Aboriginal peoples as a "cheeky bugger" with a complicated relationship to people (Berndt and Berndt 1977). While the now extinct thylacine is far more commonly depicted in aboriginal rock art over 400 years old, stencils of dingo paws and groups of human hands in rock shelters from Mutawintji in western New South Wales, attest to that relationship (Gunn et al., 2010). Like the coyote and First Nations Peoples, the Aboriginal people of Australia and the dingo have both survived intense and brutal efforts to eradicate them in a country colonized by Europeans.

Several other points of recent dingo research might further address our last question about predator facilitated biodiversity. Just as the Cornell Ornithology Lab concluded domestic cats have killed billions of birds and small mammals in the U.S., a similar scenario is happening

in Australia, where cats are responsible for the decimation of small marsupials, birds, and reptiles (Trouwborst et al., 2020). Except the dingo, where they are allowed to exist, appears to be creating its own ecology of fear, as they not only kill and eat feral cats (likely far more often than coyotes do, as dingoes are capable of taking even large feral pigs), but also create an intense landscape of fear that pushes cats closer to humans for safety. Camera trap research from Deakin University in 2017 showed dingoes consistently restricted the hours that feral cats hunted, limiting their predation to later in the morning hours, after two am, well after dusk when many small native animals are most active. Trap footage from southwest Queensland, Central Australia, and Western Australia all uncovered partitioned habitat patterns that show that where dingoes, like coyotes, are present, cat activity is restricted spatially and temporally and native animals benefit (Legge et al., 2017).

Unfortunately, the same kind of indiscriminate poison campaigns used in N. America have been employed for just as long in Australia, and the justifications are much the same too. Compound 1080 is dropped by plane across Australia to protect sheep and supposedly, native fauna from dingoes, despite an increasingly vocal body of scientists, indigenous peoples, and citizens who are opposed to poisoning dingoes and point out they are ecologically and culturally indigenous native animals (Wallach et al., 2010, 2017: Legge et al., 2017; Letnic and Crowther 2020; Fisher et al., 2021). In reality, randomly implemented toxicant campaigns may have backfired almost as dramatically in the outback as they have with coyotes in the states, but with a "cheeky" dingo twist.

That twist was documented in a study from 2020, which reported some strange findings regarding cranial size in poison baited-area dingoes (Letnic and Crowther 2020). Letnic and Crowther investigated the morphology of dingoes from three areas that have been exposed to

poisoning continuously over a 60-year period and a region where baiting had been banned. Using dingo skulls dated from 1930 to the present day, they measured for total cranial lengths to estimate body size. After examining more than 500 skulls, Letnic and Crowther found that in baited regions, female dingo skulls have grown 4.5 millimeters longer on average, while male skulls are 3.6 millimeters longer. The morphological changes observed equate to a roughly six and nine percent jumps in body mass in males and females (Letnic and Crowther 2020). This is reminiscent of the swift morphological and dental changes observed in coyotes at the end of the Quaternary Extinctions, under intense pressure from other predators. This evolutionary gauntlet favored smaller and more adaptable coyotes.

The anthropogenic gauntlet the dingo faced in the last 60 years seems to have conversely selected for larger body size, as compound 1080's lethality is tied heavily to body mass (ASM, 2012; Hinton et al., 2019). Letnic and Crowther postulate that because overuse of products like hand sanitizer, antibiotics, Raid, and Roundup produce novel adaptations in organic life forms like bacteria, insects, and weeds, the same kinds of unintended evolutionary responses may manifest in large mammals that experience long term exposure to toxicants like 1080 (Letnic and Crowther 2020).

Like the coyote, much of the debate around how the dingo is managed is contentious and is based more on ideology than biology. Everyone has an opinion about the species- invasive, indigenous, native, feral, a savior or a scourge. In that way, the "dingo situation" is also like a mirror of America's "coyote situation." The mismanagement of both canids seems to serve as a kind of ideological Rorschach test that highlights the kind of global attitudes about predators that must be addressed if there is to be any hope of restoring ecosystems in the face of climate change and the looming sixth mass extinction.

CHAPTER 10

Conclusions, Wolves, Willows, and the Hope of Rewilding

In January 1995 I helped carry the first grey wolf into YellowStone, where they had been eradicated by federal predator control policy only six decades earlier. Looking through the crates into her eyes, I reflected on how Aldo Leopold once took part in that policy, then eloquently challenged it. By illuminating for us how wolves play a critical role in the whole of creation, he expressed the ethic and the laws which would reintroduce them nearly a half-century after his death.

— Bruce Babbitt, former Secretary of the Interior

When a proposal was made by biologists working for the Interior Department in 1990 to reintroduce gray wolves to the oldest and grandest national park in N. America, YellowStone, the proposal was (and still is) extremely controversial. However, it was eventually approved, and between 1995 and 1996 biologists released 31 Canadian gray wolves into the 3,473-mile wilderness, which spans 3 states, Wyoming, Idaho, and Montana. For the first time in over 70 years the park's predator guild was restored, and in a matter of a few years the changes to the park's ecology were dramatic. Numbers of elk, at their peak 17,000 animals, were always considered too high for the carrying capacity of the ecosystem and were reduced to under 9,000. The elk, who once loitered in large herds in lower elevations, were driven higher into the mountains (to the benefit of cougars and irritation of human hunters) or onto private ranges to avoid wolf depredation. Immediately this allowed aspen, cottonwoods, and willow to begin to regrow on once denuded riverbanks, which provided more browsing for nursing moose and

beaver, who improved water quality, increasing the number of cutthroat salmon that spawned and hatched, which was a boon for river otters and eagles (Ripple and Beschta 2005, 2012).

Equally dramatic was the top-down effects on other animals like ravens, mink, and grizzly bears (especially sows with cubs) that benefited from having wolf kills to scavenge reliably year-round. Coyote populations, previously the apex canid in the park for 70 years, and (as Aldo Leopold might have expected to happen had he lived to see wolves brought back) initially fell in some places by 90 percent and have since stabilized (Crabtree and Sheldon 1999; Ripple et al., 2012). No part of YellowStone, from eagles and otters to wildflowers, was not touched in some way by the restoration of the natural complement of carnivores. Today the restoration of gray wolves in America is heralded globally as a true conservation success story. Aldo Leopold's vision of wildlife management that incorporated the entire biotic community, including predators, seemed to have been realized in America, the Park Service was finally starting to think like a mountain.

Some have called this rosy ecological narrative the “Disneyfication” of wolves' role as “brutal” killers, as they have whittled the once massive elk herds down dramatically, but the park's ecology seems to tell its story for itself (Geist, 2007; Geist, 2009; Geist and Graves 2009; Ripple, 2012; Mahoney and Geist 2019). The dire predictions of hunting and ranching groups that elk would be decimated by ravening wolf packs have not come to fruition (NPS, 2020). Wolf predation on livestock outside the park remains low, for which ranchers are compensated by federal funds, and accounts for less than 1 percent of livestock losses (Treves et al., 2016; Wielgus and Peebles 2014; Mosley et al., 2020). Nor have murderous wolves descended from the mountains, guided by the smell of hot dogs and smores to devour tourists in the campgrounds (Geist, 2007; Geist and Graves 2009). On average around four million people visit the

YellowStone every year, and in the 26 years since reintroduction, there has not been a single wolf attack on a human being in the park due to non-lethal management techniques (NPS, 2021).

The elk numbers in the park did drop substantially, but those numbers had been unsustainable for decades, which was glaringly apparent in hard winters when park staff was forced to euthanize starving elk herds that became weak and trapped in snowdrifts (Wilmers et al., 2020). Park biologists are hopeful that bringing back wolves and trimming down the elk herds to carrying capacity will also make them more resilient, and able to withstand abrupt climate changes and diseases like Chronic Wasting Disease, which has never gained a foothold in the park likely due to its robust predator guild.

Today, Americans everywhere seem to want even more of their nation's wildlife back, as the ESA enjoys widespread support from four out of five Americans of both political parties, and polling indicates widespread opinions toward carnivores continue to improve, especially among young people (Bruskotter et al., 2018; Eeden et al., 2017, Eeden et al., 2020). This may all be very good news in the long run for ecologists. Recently, to stabilize and improve degraded ecosystems more researchers, activists, and organizations, including the United Nations and the International Union for the Conservation of Nature (the U.N and the IUCN), have been adopting and proposing a new form of restorative ecology known as "rewilding". Rewilding, a form of applied conservation ecology, is essentially the act of intentionally and directly reintroducing native species to restore previous ecological systems and services.

Gray wolves in YellowStone are now considered the original textbook example of successful rewilding, and like many of America's best conservation ideas, rewilding is being adopted across the globe. Except not everyone believes predators can restore ecosystems in what

are “settled" anthropogenic landscapes, or that carnivores should even be allowed to self-manage their numbers (Geist, 2007; Geist and Graves, 2008; Mahoney and Geist 2019). Notably, rewilding is exactly the kind of ecological intervention described by the NAM authors V. Geist and Shane Mahoney as the misguided meddling of “protectionists” and “Nature Knows Besters,” that results in what they call “predator-pits” (Mahoney and Geist 2019; p. 16-19).

However, they are part of an increasingly small and irrelevant minority of resistance to this philosophical revolution in conservation ecology, as the movement that started in America with wolves is gaining significant traction among conservationists (Phoebe and Greenfield 2021). As of 2021, the beginning of what the U.N is calling “the UN Decade on Ecosystem Restoration,” diverse rewilding plans are beginning to be implemented all over the planet (UN, 2021). In Europe beavers, bison, white tail eagles, butterflies, and wildcat reintroduction efforts are all underway in the U.K (Miranda et al., 2019). In Switzerland, Germany, and Slovenia Eurasian lynx have been released, and most recently to Scotland, where they have been extinct for 1500 years (Ovenden et al., 2019). The cheetah, declared extinct in India in 1952 when the maharaja shot the last three, is being reintroduced in 2022 (Cockburn, 2021). Large herbivores are being restored as well. Work by the European Wildlife Bank to reintroduce the closest living relatives of the auroch, (the tauros), as well as bison and horses, have seen the Pleistocene beasts humans once painted so reverently on the walls of Lascaux and Chauvet returned to the landscapes of Europe (Rewilding Europe, 2021).

In the Americas, rewilders have turned their sights on bringing back the continent's largest native cat, the jaguar (*Panthera onca*). A mother jaguar and her cubs were released in 2021 in the Ibera National Park in Argentina in 2021 and plans for the release of giant river otters are next in the park (Fundación Rewilding Argentina, 2021). While on the U.S side of the

Mexico border, Sanderson et al., published a study in 2021 making the case for the reintroduction of jaguars to the American southwest, where they had lived as recently as the 1950's (Sanderson et al., 2021). The IUCN Red List considers restoring historical ranges and increasing populations of threatened species like the jaguar, cheetah, and wolf to be critical steps toward the full recovery of the ecosystems those keystone species inhabit (IUCN, 2013; Grace et al., 2019; Sanderson et al., 2021). Recovery is particularly important when species have long reaching trophic and ecological impacts as apex predators, or like beavers and bison, are landscape engineers (Estes et al., 2011; Crumley, 2015).

While the specter of climate change and the anthropogenic 6th mass extinction has led many observers to resignation and despair, rewilding can offer individuals and humanity hope and give us something better to do than simply bear witness to a dying world. However, this revolution in applied ecological management, in which humans restore rather than destroy and ultimately seek coexistence rather than control, will require that the people who are resistant to such ideas, and conversely, often stand to be most affected by reintroduction of predators, be considered, convinced, and collaborated with in these efforts. Resistance to reintroducing and tolerating wildlife, and especially predators, thus represents one of the most complicated and important challenges facing ecosystem and biodiversity restoration, as well as the fight against climate change (Ripple et al., 2014).

Deeply entrenched American values, views about dominion over nature, firearms, game management and man's right to consume nature without more profound ethical obligations to a biotic community to which he too belongs, all slow the march toward better conservation outcomes. Old, long simmering resentments toward federal interventions and neoliberal rejections of regulations about how people can protect their property and livestock means there

will continue to be political opposition from rural segments of American society to the very idea of being “forced” to live in proximity to any predator. Biological science alone will not be enough to address this issue.

Attitudes toward wildlife, and especially the coyote, are defined by core beliefs derived from socio-cultural contexts, such as individualism, and beliefs about dominion over nature, egalitarianism, and mutualism (Bruskotter et al., 2018). Thus, the intensity of human persecution of animals like the coyote are dictated by various measurable psychological and cultural factors, as well as being situated in livelihood and socioeconomic contexts. The lack of ethical harvest laws in states like Wyoming and Idaho, where people can legally chase and run over some animals for fun (wolves and coyotes) but not others (elk and deer) with snowmobiles, exemplifies this paradigm, as well as highlighting the NAMs worst failures. Because values and attitudes are psychological factors that directly shape behaviors toward wildlife, these attitudes and the people who hold them must be addressed to restore ecosystems effectively.

In a 2021 study of how humans can negatively impact wildlife’s ability to navigate and inhabit landscapes, Ghoddousi et al., defined acts like targeting predators for lethal removal as a form of “anthropogenic resistance,” and discussed the factors that lead to this resistance (Ghoddousi et al., 2021; p. 39):

> The US, since European colonization, has been defined by values of mastery (i.e., controlling the social and natural environment through self-assertion values) which have been entwined over time with livestock-rearing livelihoods and support for gun rights across significant portions of the western half of the country. The combination of mastery and domination values on the one hand, and economic dependence on livestock on the

> other, leads people in many parts of the US to use guns and other lethal control mechanisms to address large carnivores…

Because both human behaviors and policies contribute to shaping anthropogenic resistance, Ghoddousi et al., propose a synthesis which combines spatial data about species movements through landscapes combined with how those movements are impacted by geography, climate, human actions, economics, and politics. Ghoddousi et al., point out that negative attitudes toward some wildlife appear to often be tightly spatially clustered and could be literally mapped by spatially explicit models. Maps of anthropogenic resistance, essentially heatmaps of anti-predator sentiment or high mortality due to poaching and culling, could be used to create and inform more effective wildlife restoration initiatives. An example of a more anthropogenically informed initiative might be green corridor planning that avoids or otherwise targets interventions to address such resistance hotspots on the ground (Krester et al., 2009; Bowman et al., 2004; Morzilo, 2007). In their discussion of synthesizing data about opinions and practices, Ghoddousi et al., mention challenges to collecting data on anthropogenic resistance (Ghoddousi et al., 2021; p. 48):

> ...an understanding of the range of direct and indirect social science methods that apply in this context is required. Direct methods (e.g., surveys, interviews, or focus groups) aim to measure specific psycho-social characteristics of humans that lead to key behaviors that may affect wildlife.

In the above passage Ghoddousi et al., briefly outline the kind of social science methods that may be most useful for collecting data on anthropogenic resistance to wildlife, which all sounds suspiciously like the work of an anthropologist. Because of the unique challenges

inherent to investigations in contentious cultural topics, anthropology, and more specifically the nascent subfields of anthrozoology or ethnobiology, may have a valuable role in bridging interests of invested parties through applied investigations couched within dual frameworks of cultural and biological paradigms. Investigating why millions of people are willing to pay good money for just a chance to see wolves in YellowStone, while a smaller segment of Americans put bumper stickers on their vehicles that read “Smoke a pack a day” with a wolf in crosshairs- all seems a better job for an anthropologist than a canid biologist. Understanding this cultural divide will be crucial in improving American conservation practices because these are the same attitudes that prevail in the nation’s archaic war with native predators.

CHAPTER 11

Recommendations, the New Principles of Rewilding

One of the anomalies of modern ecology is the creation of two groups, each of which seems barely aware of the existence of the other. The one studies the human community, almost as if it were a separate entity, and calls its findings sociology, economics and history. The other studies the plant and animal community and comfortably relegates the hodge-podge of politics to the liberal arts. The inevitable fusion of these two lines of thought will, perhaps, constitute the outstanding advance of this century.

Aldo Leopold, A Sand County Almanac, 1949

A great turn in conservation values lies in the current global efforts to undo some of the worst damage humans have done to ecosystems. This great turn represents the continued maturation of the relationships and responsibilities humans have to their biotic community as "plain members" (Leopold, 1949). The nascent philosophies and ethical proscriptions of the rewilding movement acknowledges an overdue shift in values representing a further move away from colonialist Utilitarian notions of controlling and "managing" nature for short term human benefits, to one that seeks coexistence and greater respect between local, biotic, and indigenous communities. But how could this paradigm work in the U.S, where lethal removal of predators still abounds, and conservation appears to be perpetually married to outdated "game" management proscriptions?

History should remind anyone paying attention that in America such great turns in the spirit of conservation legislation are the rule, not the exception (Roosevelt, 1914; Leopold, 1933; Flores, 2016; Organ et al., 2012; Nijhuis, 2021). Americans like "big" ideas and bold actions, and as a nation have the capacity for great legislative conservation change several times every century. Our own time feels ripe for such a change, after all, for the first time in American history an indigenous woman, Deb Haaland, is the Secretary of the Interior Department. If history has shown anything else to be true, it is that the political will of the public can move mountains. Thus, involved conservation researchers and practitioners should be paying particular heed to Leopold's suggestion that bridging the social and the scientific worlds might allow some of the greatest restorative ecological accomplishments of our time (Leopold, 1949).

To do this, perhaps what America and the world needs most is a new model of wildlife conservation to replace the North American Conservation Model, which biological science, ethics, and public opinion increasingly seem to be outgrowing. The IUCN may have recently developed and begun to implement just such a model (IUCN, 2021). In conjunction with dozens of leading "pioneering rewilders" the IUCN has developed a framework of 10 basic principles, based on literature reviews, surveys, and communications with experts, that is both science-based and community-focused (IUCN, 2021):

Table 6.1 The New Principles of Rewilding

1. Rewilding utilizes wildlife to restore previous trophic interactions and ecosystems.
Successful rewilding is nature-led, self-sustaining, and relies on accommodating predation, herbivore competition and other biotic and abiotic (weather, fires, etc.) interactions to sustain an ecosystem that self-regulates its own populations. Where appropriate, interactive keystone species that have roles in maintaining the ecosystem should be reintroduced or threatened populations supported.

2. Rewilding employs landscape-scale reintroduction planning that considers core areas, corridor connectivity, and potential for human-animal coexistence.

At the landscape scale, it is crucial for successful rewilding that core areas provide a secure space that accommodates the full array of species which comprise self-sustaining natural ecosystems, including predators like lions, wolves, and bears. These areas are represented by either legal designation (i.e., national parks) and or under private management (such as rewilded estates in the U.K).

3. Rewilding focuses on the recovery of ecological processes, interactions and conditions based on reference ecosystems.

Rewilding should aim to restore the food-webs of various self-sustaining ecosystems and specifically the abundance, natural migration patterns, and habitat dynamics of native landscape engineer species like beavers, bison, and prairie dogs. To do this rewilding should make use of ecological references which can be based on contemporary near-natural reference areas and/or scientific evidence supported by indigenous and local knowledge.

4. Rewilding recognizes that ecosystems are dynamic and constantly changing.

Healthy ecosystems are not "beautiful parks" or static dioramas of nature. Temporal changes, both allogenic (external) and autogenic (internal), are fundamental attributes of ecosystems and evolutionary processes critical to ecosystem function. Allogenic factors include storms, floods, and wildfire cycles. Equally as important are changes from autogenic processes such as pollination, nutrient cycles, decomposition, seed dispersal, and predation. Conservation planning for rewilding should ultimately facilitate the space and connectivity needed for large scale biotic processes to have free reign without human impediment or constraint. The removal of dams to restore rivers and fish migration routes constitute one aspect of this proscription.

5. Rewilding should try to anticipate the effects of climate change, and where possible, act as a tool to mitigate the worst impacts on people and ecosystems.

Anthropogenic impacts of climate change are rapid and pervasive, creating the need to anticipate impacts on rewilding. Rewilding projects have medium to long-term timescales that must consider the long-term outcomes of global climate change like sea level rise, storm surge events, etc. Rewilding can also be considered as an example of a Nature-based Solutions approach (NbS) with the potential to ameliorate and/or tackle the effects of climate change. This includes attempting to mitigate the impacts of climate change on ecosystems and increasing the capture of carbon through restoration of ecosystems like mangrove swamps, which act as storm buffers and carbon sinks.

6. Rewilding requires local engagement and support.

Rewilding efforts should be inclusive of all stakeholders, be they indigenous, wild, or local. Best rewilding practices embrace participatory based approaches that include transparent consultation with participant communities in the planning process for all projects. Rewilding should encourage public understanding, acceptance and appreciation of nature and should apply targeted interventions to address existing conflicts with wildlife. Financially incentivizing landowners to keep ungulate migration routes undeveloped or paying them to remove old fences that block these routes (instead of federally subsidizing lethal predator removal), might constitute the kind of solution this principle envisions.

7. Rewilding is informed by science and indigenous and local knowledge.

Cooperative ecosystem restoration efforts between researchers, and indigenous and local collaborators can generate the greatest benefits, creating an amalgam of innovation and helping form best practices through mutual learning and acknowledgement of all involved parties. All these forms of knowledge are important for the success of rewilding projects and can help inform adaptive management frameworks. Local experts can provide detailed knowledge of sites, their histories, and processes, all of which can improve rewilding outcomes.

8. Rewilding is adaptive and dependent on researcher/community monitoring and mutual feedback.

On the ground, consistent monitoring is essential to provide evidence of short and medium-term results if long-term rewilding goals are to be achieved. Community engaged and incentivized monitoring is crucial to successful monitoring of local wildlife. Positive involvement by Masai herders in monitoring adjacent lion corridors was deemed crucial to their conservation and is an example of this principle in action (Dolrenry and Hazzah, 2020).

9. Rewilding recognizes the intrinsic value of all species and ecosystems.

All wild nature has its own intrinsic value, regardless of human evaluations as game or “vermin”. Rewilding should primarily be an ecocentric, rather than an anthropocentric activity that recognizes restored nature’s ability to regulate its own systems. Where human-wildlife conflict management interventions are required, these should be the absolute minimum required and use the most ethical, targeted, and least amount of lethal removal possible.

10. Rewilding ultimately requires a paradigm shift in the relationship between humans and nature.

In alliance with global conservation communities, intensive rewilding initiatives signal widespread transformative change in the current ecology paradigm, providing hope, purpose, and motivation for engagement rather than despair in the face of climate change and the sixth mass extinction. Biodiversity loss and climate change must be addressed simultaneously, not as separate issues, but as dual symptoms of one crisis. Rewilding can address both. The most desired and beneficial outcome will result in a paradigm shift in advocacy, actions, and politics that will reform conservation efforts from "saving what is left," towards recovering functioning trophic ecosystems. Hopefully, one day soon society will no longer accept degraded ecosystems and over-exploitation of nature as an inevitable baseline for future generations to bear.

Over one-half of the 2.3 billion acres of land in America is currently utilized for agriculture, that's nearly one-third of the country being used for farms, grazing, and ranches. All these operations represent both a threat and a possible solution to biodiversity loss in the form of maintaining environments that are productive for human interests and give wildlife a place to exist and migrate. Overcoming negative beliefs about predators must start at the state-federal level and include diverse rural communities to achieve lofty goals like the 30 x 30 Initiative, which seeks to preserve and restore connectivity to at least 30 percent of N. America's remaining wildlands by 2030 (Lieberman, 2021). In January of 2021 President Biden signed an executive order which committed to work toward this goal, as well as making addressing climate a national priority (Lieberman, 2021). Currently some 12 percent of land in the U.S is held in some state of conservation (USGS, 2018). To reach the goal of conserving 30 percent of lands by 2030 another 440 million acres must be protected.

However, there is already resistance to the 30 x 30 Initiative in the agriculture sector, which uses some 900 million acres for growing crops and livestock in the U.S. In states like Kansas and Iowa most of the land acreage already lies in private hands. Thus, making room and

generating goodwill toward the presence of predators and other wildlife on public grazing lands and, more importantly, thousands of acres of privately owned land, will likely become critical to future ecosystem restoration efforts as undeveloped land continues to disappear rapidly. Convoluted and thorny contexts where ethics, economics, emotions, public policy, and biological science meet may still seem a field too fraught with potential epistemological leg-traps for a sensible biologist. But perhaps it is *exactly* this kind of ground that is good habitat for the anthropologist and will prove prime territory for novel types of applied ecological anthropological praxis (Alves, 2012).

The coyote, unlike wolves, condors, polar bears, and jaguars, does not require our reintroduction or help to survive. In contrast, they are a wildly unusual outlier, a predator that seems supernaturally immune to the wrath of humans. As the ancient, shape-shifting anti-hero of our story, its return in the face of nearly unlimited human persecution and hubris might even qualify the species as the perfect emblem for wild things too wily to die, and thus, hope for all life in the Anthropocene. Clearly the millions of dollars still being wasted on the "predator-problem-coyote-placebo" would be better spent on restoring degraded ecosystems and connecting existing corridors of green space to help ameliorate biodiversity loss (Shivik, 2014).

If we can learn to accept the wildlife like coyotes around us and embrace a new ecological paradigm that commits to the decolonization of conservation by prioritizing coexistence over the commodification of game species and an illusion of control over nature we have never really had, perhaps wildlife management can be improved for everyone and every living thing involved. As we have seen many times in our story, indigenous narratives of the coyote as a clever, adaptable, and nearly indestructible survivor are very accurate depictions. The ecological warning in the story Coyote Finishes the People may also be very apt, as the coyote's

adaptations and recent dramatic return both coincided sharply with the ecological havoc of several small windows of time, such as the Pleistocene Extinctions, and the post-Columbian Great Dying, which continues on in the form of persecution of native N. American species.

Modern America's tumultuous chapters of the coyote story seems to have exposed nearly everything that must be reformed about current conservation policy if America and the world is to have hope of moving forward with effective ecosystem restoration. The massive heat waves, droughts, flooding, increasingly severe hurricanes, and raging forest fires of the last decade will undoubtedly continue to worsen and reaffirm that humanity must act now. A new kind of ecological mandate and model of American conservation principles that values *all* native wildlife, not just game species, may someday guide a yet unseen and better future version of Wildlife Services that could benefit all Americans at the front lines of efforts to respond to climate change. This kind of revolutionary agency would conceivably implement nonlethal measures like highly subsidized or free livestock guardian dogs, range riders, and hot fences first, instead of gunships, snares, and poison.

Such an agency might also spend its budget improving degraded rangelands and removing old fences that block miles of ungulate migration routes, instead of trying to "manage" game by feeding elk hay, sponsoring predator bounties, and gassing thousands of prairie dogs a year. This reformed version of Wildlife Services could be exactly the kind of conservation agency America and the world needs now to fight the worst consequences of climate change, stem biodiversity loss, and restore the wild faster so it can start to save itself and us. While this might all sound like the pipedream of so-called "Nature Knows Besters" to some, perhaps that is the ultimate moral of this modern fable about the coyotes return in the Anthropocene, and what he really came back to show the people.

BIBLIOGRAPHY

Aberth, J. (2007). *The first horseman: disease in human history*. Pearson Prentice Hall. p. 47–75.

Abram, N. J., McGregor, H. V., Tierney, J. E., Evans, M. N., McKay, N. P., & Kaufman, D. S. (2016). Early onset of industrial era warming across the oceans and continents. *Nature, 536* (7617), p. 411.

Adrian G. Fisher., Mills, C.H., Lyons, M. (2021). Remote sensing of trophic cascades: multi-temporal landsat imagery reveals vegetation change driven by the removal of an apex predator. *Landscape Ecology, 36*(5) p. 1341-1358.

Alves, R. (2012). Relationships between fauna and people and the role of ethnozoology in animal conservation. *Ethnobiology and Conservation, 1.*

Ambrose, Stephen E. (1996). *Undaunted Courage: Meriwether Lewis, Thomas Jefferson, and the Opening of the American West.* Simon and Schuster, New York. p. 511.

American Society of Mammologists (ASM). (1999). Resolution on Mammalian Predator Control in the United States. American Society of Mammalogists.

American Society of Mammalogists (ASM). (2012). Presidential letter to United States Department of Agriculture, Animal Plant Health Inspection Service urging redirection of Wildlife Services management operations toward non-lethal control.

Artelle, Kyle., Reynolds, John., Treves, Adrian., Walsh, Jessica., Paquet, Paul., Darimont, Chris. (2018). Hallmarks of science missing from North American wildlife management. *Science Advances, 4* (3).

Audubon, J. J. (1835). *Ornithological Biography or an Account of the Habits of the Birds of the United States of America* (etc.). Adam Black.

Auerbach, M. (2016). Beginnings: The Journals of Lewis and Clark. Defining Documents: *Environment & Conservation (1791-2015),* p. 9–16.

Aune, K., Jørgensen, D. & Gates, C. (2017). *Bison bison*. The IUCN Red List of Threatened Species.

Banks, R. C. (1979). Human related mortality of birds in the United States. Special Scientific Report—Wildlife N. 215 US Dept. of the Interior—Fish and Wildlife Service.

Barrett, S. A. (1906). A Composite Myth of the Pomo Indians. *The Journal of American Folklore, 19* (72), p. 37–51.

Bar-Ona, Y. M., Phillips, R., & Milo, R. (2018). The biomass distribution on Earth. *Proceedings of the National Academy of Sciences of the United States of America*, *115*(25), p. 6506–6511.

Beckwith, Martha W. (1937). *Mandan-Hidatsa Myths and Ceremonies.* New York: American Folklore.

Bekoff, M., and Wells, M.C. (1986). Social ecology and behavior of coyotes. *Advanced Study of Behavior*, *16*, p. 251–338.

Bekoff, Marc. (1995). Coyotes: Victims of their own Success. *Canid News 3*, p. 1-6.

Bender, N. E. (2011). Theodore Roosevelt in the Badlands: A Young Politician's Quest for Recovery in the American West. *Library Journal*, *136*(2), p. 75.

Berger, K. (2006) Carnivore-livestock conflicts: Effects of subsidized predator control and economic correlates on the sheep industry. *Conservation Biology*, *20*(3), p. 751 – 761.

Berger K. M., Gese E. M., Berger J. (2008). Indirect effects and traditional trophic cascades: a test involving wolves, coyotes, and pronghorn. *Ecology*, *89*, p. 818–828.

Bergstrom B. J., Arias L.C. Davidson, A. Ferguson A. W. Randa L. A. Sheffield S. R. (2014). License to kill: reforming federal wildlife control to restore biodiversity and ecosystem function. *Conservation Letters*, *7*, p. 131–142.

Bergstrom, B.J. (2017). Carnivore conservation: shifting the paradigm from control to coexistence, *Journal of Mammalogy*, *98*, 1, (8), p 1–6.

Berndt, R.M. and C.H. Berndt. (1977). *The World of the First Australians*. 2nd ed. Sydney. Ure Smith Press.

Beschta, R. L., and Ripple, W. J. (2010). Recovering riparian plant communities with wolves in northern YellowStone, USA. *Restorative Ecology*, *18*, p. 380–389.

Beuchler, M.; G. Servheen (2008). "The North American Model of Wildlife Conservation: affirming the role, strength, and relevance of hunting in the 21st century". *Transactions of the North American Wildlife and Natural Resources Conference*, *73*, p. 163–179.

Bogezi, Carol., van Eeden, Lily., Wirsting, Aaron., Marzluff, John. (2019). Predator-Friendly Beef Certification as an Economic Strategy to Promote Coexistence Between Ranchers and Wolves. *Frontiers in Ecology and Evolution, 7.*

Boas, Franz. (1898). Introduction. In Traditions of the Thompson River Indians of British Columbia. Collected and annotated by James Teit. Boston, New York: Published for *The American Folklore Society* by Houghton, Mifflin; London.

Boas, Franz. (1918). *Kutenai Tales*. American Folklore Society. *Bureau of American Ethnology Bulletin 59*. Washington, DC. U.S. Government Printing Office.

Bois, Constance Goddard Du. (1906). "Mythology of the Mission Indians". *The Journal of American Folklore, 19* (72), p. 52–60.

Bolen, Eric (2003). *Wildlife Ecology and Management*. New Jersey: Prentice Hall.

The Boone and Crockett Club. (2021). The Origins of Fair Chase. Retrieved from: https://www.boone-crockett.org/origins-fair-chase

Bowman, J.L., Leopold, B.D. Leopold, F.J. Vilella, Gill, D.A. (2004). A spatially explicit model, derived from demographic variables, to predict attitudes toward black bear restoration. *Journal of Wildlife Management, 68*, p. 223-232.

Braczkowski, A. R., O'Bryan, C. J., Stringer, M. J., Watson, J. E. M., Possingham, H. P., & Beyer, H. (2018). Leopards provide public health benefits in Mumbai, India. *Frontiers in Ecology & the Environment, 16*(3), p. 176–182.

Bragina, E. V., Kays, R., Hody, A., Moorman, C. E., Deperno, C. S., & Mills, L. S. (2019). Effects on white-tailed deer following eastern coyote colonization. *The Journal of Wildlife Management, 83*(4), p. 916–924.

Brechin, Gray. (1996). Conserving the Race: Natural Aristocracies, Eugenics and the U.S. Conservation Movement. *Antipode 28,* p. 229–245.

Bruskotter. John. A., Vucetich, John., Slagle, Kristina, M., Berardo, Ramiro., Singh, Ajay., Wilson, Robyn. S. (2018). Support for the U.S. Endangered Species Act over time and space: Controversial species do not weaken public support for protective legislation. *Conservation Letters*, *11*(6), p.1.

Burchsted, F. F. (1993). Thomas Say: New World Naturalist. ISIS: *Journal of the History of Science in Society, 84*(4), p. 805–807.

Bureau of Biological Survey. (1929). *Report of the chief of the Bureau of Biological Survey*. Washington, D.C: U.S. Dept. of Agriculture, Bureau of Biological Survey.

Cain, S.A., J.A. Kadlec, D.L. Allen, R.A. Cooley, M.H. Hornocker, and F.H. Wagner. (1971). *Predator control—1971. Report to the President's Council on Environmental Quality and the U.S. Department of the Interior by the Advisory Committee of Predator Control*. University of Michigan Press, Ann Arbor.

Carroll, M. (1981). Lévi-Strauss, Freud, and the Trickster: A New Perspective upon an Old Problem. *American Ethnologist, 8*(2), p. 301-313.

Carson, R., Wilson, E. O., Lear, L. J., Darling, L., & Darling, L. (2002). *Silent spring* (First Mariner books edition.). Houghton Mifflin.

Carys E. Bennett, Thomas, Richard., Williams, Mark., Zalasiewicz, Jan., Edgeworth, Matt., Miller, Holly., Coles, Ben., Foster, Alison., Burton, Emily., Marume, Upenyu. (2018). The

broiler chicken as a signal of a human reconfigured biosphere. *Royal Society Open Science*, *5*(12).

Casanovas J. G. Barrull, Joan., Mate, Isabel., Zorrilla, Juan., Ruiz-Olmo, Jordi., Gosàlbez, Joaquim., Salicrú, Miquel (2012). Shaping carnivore communities by predator control: competitor release revisited. *Ecological Research*, *27*, p. 603–614.

Ceballos, G.; Ehrlich, A. H.; Ehrlich, P. R. (2015). *The Annihilation of Nature: Human Extinction of Birds and Mammals*. Baltimore, Maryland. Johns Hopkins University Press.

Ceballos Gerardo, Ehrlich Paul R., & Dirzo Rodolfo. (2017). Biological annihilation via the ongoing sixth mass extinction signaled by vertebrate population losses and declines. *Proceedings of the National Academy of Sciences of the United States of America*, *114*(30), p. E6089–E6096.

Chapron, G., Treves A. (2016). Blood does not buy goodwill: allowing culling increases poaching of a large carnivore. Proceedings of the Royal Society of London B: *Biological Sciences*, 283, p. 27170719.

Chih-Ming, Hung., Pei-Jen L, Shaner., Robert, Zink., Wei-Chung, Liu., Te-Chin, Chu., Wen-San, Huang., Shou-Hsien, Li (2014). Drastic population fluctuations explain the rapid extinction of the passenger pigeon. Proceedings of the National Academy of Sciences of the United States of America, 111(29), p. 10636–10641.

Cockburn, Harry. (2021) Rewilding: Cheetahs to be reintroduced to India 70 years after last one was killed. The Independent. United Kingdom. Retrieved from: https://www.Independent.co.uk/climate.change.news

Colman, N. J., C. E. Gordon, M. S. Crowther, and M. Letnic. (2014). Lethal control of an apex predator has unintended cascading effects on forest mammal assemblages. Proceedings of the Royal Society B: *Biological Sciences 281*, p. 20133094.

Conner, M. Jaeger, T. J. Weller, and D. R. Mc- Cullough. (1998). Effect of coyote removal on sheep depredation in northern California. *Journal of Wildlife Management 62*, p. 690- 699.

Cook, David. (1998). *Born To Die*. Cambridge University Press.

Crabtree, RL., Sheldon, JW. (1999). The Ecological Role of Coyotes on YellowStone's Northern Range. *YellowStone Science*, *7*(2), p. 15-23.

Crooks, K.R., Soulé, ME. (1999). Mesopredator release and avifaunal extinctions in a fragmented system. *Nature 400*, p. 563–566.

Crusafont Pairó, M. (1950). La cuestión del llamado Meótico español. Arrahona. *Journal of Iberian Geology, 40*, p. 41-48.

Crumley, J. (2015). *Nature's architect: The Beaver's return to our wild landscapes*. Salford, UK. Saraband Press.

Cumo, Christopher. (2015). *The Ongoing Columbian Exchange: Stories of Biological and Economic Transfer in World History: Stories of Biological and Economic Transfer in World History*. ABC-CLIO.

Dashnaw, M.R. (2014). An Unframeable Icon: Coyote, Casta and the Mestizaje in Colonial New Spanish Art. Masters Thesis. Arizona State University Press.

Dauphiné, N., Cooper, R. J. (2009). Impacts of free-ranging domestic cats (*Felis catus*) on birds in the United States: a review of recent research with conservation and management recommendations. *Proceedings of the Fourth International Partners in Flight Conference: Tundra to Tropics*, p. 205–219.

Denevan, W. (1992). The Pristine Myth: The Landscape of the Americas in 1492. *Annals of the Association of American Geographers*, 82(3), p. 369-385.

Dirzo, Rodolfo., Young, Hillary, S., Galetti, Mauro., Ceballos, Gerardo., Isaac, Nick J. B., Collen, Ben. (2014). "Defaunation in the Anthropocene" (PDF). *Science*, *345*(6195), p. 401–406.

Dixon, Roland B. (1908). Achomawi and Atsugewi Tales. *The Journal of American Folklore*, *21*(81), p. 159–177.

Dolrenry, L., Hazzah, L. Frank (2020). Corridors of tolerance through human-dominated landscapes facilitate dispersal and connectivity between populations of African lions *Panthera leo*. *Oryx*, *54*, p. 847-850.

Dorsey, James Owen. (1892). Nanibozhu in Siouan Mythology. *Journal of American Folklore 5*, p. 293-304.

Dorsey, George. (1904). *Traditions of the Skidi Pawnee*. New York: *American Folklore Society.*

Dorsey, James O., Swanton, John. (1912). *A Dictionary of the Biloxi and Ofo Languages*. Bureau of American Ethnology Bulletin 47. Washington, DC. U.S. Government Printing Office.

Doub, J. P. (2013). *The Endangered Species Act: history, implementation, successes, and controversies*. (Edition 1). CRC Press.

Dye, K. (1996). Blood of the Monster: The Nez Perce Coyote Cycle. *Oregon Historical Quarterly*, *97*(4), p. 485–487.

Dyer, T. G. (1992). *Theodore Roosevelt and the idea of race*. Baton Rouge, LA. LSU Press.

Eastern United States Predator Calling Championship (EUSPCC). (2021). About the EUSPCC. Retrieved from: https://www.facebook.com/groups/332718573812805/

Eccleston, Charles H. (2008). *NEPA and Environmental Planning: Tools, Techniques, and Approaches for Practitioners*. CRC Press.

Eeden, L.M., Dickman, C.R., Ritchie, E.G. (2017). Shifting public values and what they mean for increasing democracy in wildlife management decisions. *Biodiversity Conservation*, *26*, p. 2759–2763.

Eeden, L. M., Slagle, K., Newsome, T. M., Crowther, M. S., Dickman, C. R., & Bruskotter, J. T. (2020). Exploring nationality and social identity to explain attitudes toward conservation actions in the United States and Australia. *Conservation Biology*, *34*(5), p. 1165–1175.

Ellis-Felege S. N., Conroy M. J., Palmer W. E., Carroll J. P. (2012). Predator reduction results in compensatory shifts in losses of avian ground nests. *Journal of Applied Ecology*, *49*, p. 661–669.

Ellsworth, J. W., McComb, B. C. (2003). "Potential Effects of Passenger Pigeon Flocks on the Structure and Composition of Presettlement Forests of Eastern North America". *Conservation Biology, 17*(6), p. 1548–1558.

Enzler S. A., Bruskotter J. T. (2009). Contested definitions of endangered species: the controversy regarding how to interpret the phrase “a significant portion of a species’ range”. *Virginia Environmental Law Journal* 27, p. 1–65.

Estes, J. A., Terborgh, J., Brashares, J. S., Power, M. E., Berger, J., Bond, W. J., Wardle, D. (2011). Trophic downgrading of planet earth. *Science, 333*(6040), p. 301–306.

Fisher, A. G., Mills, C. H., Lyons, M., Cornwell, W. K., Letnic, M. (2021). Remote sensing of trophic cascades: multi-temporal landsat imagery reveals vegetation change driven by the removal of an apex predator. *Landscape Ecology*, *36*(5), p. 1341–1358.

Flood, J. (1983). *Archaeology of the Dreamtime*. Sydney: Collins Press.

Flores, D. L. (2016). *Coyote America: A natural and supernatural history*. New York: Basic Books.

Fox, C. H. (2006). Coyotes and humans: can we coexist? in: R.M. Timm and J. H. O’Brien (eds.). Public University of California Davis. *Proceedings 22nd Vertebrate Pest Conference*. p. 287-293.

Fuller, E. (2001). *Extinct Birds* (Revised ed.). Ithaca, New York. Comstock Publishing Associates.

Foundation for Rewilding Argentina. (2021). Bulletin on jaguar reintroduction. Retrieved from: https://rewildingargentina.org/proyecto-ibera/

Garland, Allen, E. (2013). Culling the Herd: Eugenics and the Conservation Movement in the United States, 1900-1940. *Journal of the History of Biology*, *46*(1), p. 31–72.

Gaynor, K. M., Brown, J. S., Middleton, A. D., Power, M. E., & Brashares, J. S. (2019). Landscapes of Fear: Spatial Patterns of Risk Perception and Response. *Trends in Ecology & Evolution*, *34*(4) p. 355-368.

Gehr, B., Hofer, E. J., Pewsner, M., Ryser, A., Vimercati, E., Vogt, K., & Keller, L. F. (2018). Hunting-mediated predator facilitation and super-additive mortality in a European ungulate. *Ecology and Evolution*, 8, p. 109–119.

Gehrt, S., Clark, W. (2003). Raccoons, Coyotes, and Reflections on the Mesopredator Release Hypothesis. *Wildlife Society Bulletin (1973-2006), 31*(3), p. 836-842.

Gehrt, S.D., Riley, S.P.D. (2010). Coyotes (*Canis latrans*) in: Urban Carnivores (Gehrt, S.D., Riley, S.P.D., Cypher, B.L., eds.). John Hopkins University Press.

Gehrt, SD. Anchor C, White LA. (2009). Home range and landscape use of coyotes in a metropolitan landscape: conflict or coexistence? *Journal of Mammalogy*, *90*, p.1045–1057.

Gehrt SD. (2012). Influence of the urban matrix on space use of coyotes in the Chicago metropolitan area. *Journal of Ethology 30*, p. 413–425.

Gehrt, Stanley D., Wilson, Evan., Brown, Justine., Anchor, Chris. (2013). Population ecology of free-roaming cats and interference competition by coyotes in urban parks. *PLoS ONE, 8*(9), p. e75718.

Geist, V. (1971). *Mountain sheep; a study in behavior and evolution*. University of Chicago Press.

Geist, V., S.P. Mahoney, and J.F. Organ. (2001). Why hunting has defined the North American model of wildlife conservation. *Transactions of the North American Wildlife and Natural Resources Conference 66*, p. 175-185.

Geist, V. (2007). *When Do Wolves Become Dangerous To Humans*? Alberta, Canada. The University of Calgary.

Geist, V. (2008). Essay, Part 2 Death by Wolves and Misleading Advocacy - The Kenton Carnegie Tragedy. Bone and Crockett Club (boone-crockett.org). Retrieved from: https://www.boone-crocklett.org/death-wolves-misleading-advocacy-kenton-carnegie-tragedy

Geist, V. (2008). Essay, Part 3 Beyond Wolf Advocacy, Toward Realistic Policies for Carnivore Conservation. Boone and Crockett Club (boone-crockett.org). Retrieved from: https://www.boone-crocklett.org/beyond-wolf-advocacy-toward-realistic-policiescarnivore-conservation

Geist, V., Graves, Will. (2009). *Wolves in Russia: Anxiety Through the Ages*. *Rangelands*, *31*(6), p. 36.

Gese, E.M. (2005). Demographic and Spatial Responses of Coyotes to Changes in Food and Exploitation. *Proceedings of the Wildlife Damage Management Conference*, *11*, p. 271-285.

George, K. A., Slagle, K. M., Wilson, R. S., Moeller, S. J., and Bruskotter, J. T. (2016). Changes in attitudes toward animals in the United States from 1978 to 2014. *Biology Conservation. 201*, p. 237–242.

Georgia Department of Natural Resources, Wildlife Division (GDNR). (2015). 2015-2024 Deer Management Plan. Retrieved from: https://georgiawildlife.com/sites/default/files/wrd/pdf/management/2015-2024_Deer_Management_Plan.pdf.

Ghoddousi, Arash., Buchholtz, K., Erin Dietsch, Alia., Williamson, Matthew., Sandeep, Sharma., Balkenhol, Niko., Kuemmerle,Tobias., Dutt, Trishna. (2021). Anthropogenic resistance: accounting for human behavior in wildlife connectivity planning. *One Earth*, *4*(1), p. 39-48.

Gillham, N. W. (2001). Sir Francis Galton and the Birth of Eugenics. *Annual Review of Genetics*, *35*, p. 83.

Global Forest Resource Assessment (GFR). (2010). 2010 report on global forest resources. Retrieved from: http://www.fao.org/forest-resources-assessment/past-assessments/fra-2010/en/

Goodwin, Grenville. (1939). *Myths and Tales of the White Mountain Apache*. New York. American Folklore Society.

Grace, M., Akçakaya, H. R., Bennett, E., Hilton-Taylor, C., Long, B., Milner-Gulland, E. J., Hoffmann, M. (2019). Using historical and palaeoecological data to inform ambitious species recovery targets. *Philosophical Transactions of the Royal Society*: *Biological Sciences*, 374, p. 20190297.

Grant, Madison. (1894). The Vanishing Moose and Their Extermination in the Adirondacks. *Century*, *47*, p. 345–356.

Grant, Madison. (1916). *The Passing of the Great Race, or the Racial Basis of European History*. New York. Charles Scribner's Sons.

Gunn, R.G. (1989). *Survey and Assessment of Rock Art Sites in the Mikinj Area, Western Arnhem Land*. Unpublished report to Northern Land Council, Darwin.

Hagedorn, Herman. (1921). *Roosevelt in the badlands*. New York. The University press Cambridge.

Harding, A. R. (1909). *Wolf and Coyote Trapping: A Up-to-Date Wolf Hunter's Guide, Giving the Most Successful Methods of Experienced Wolfers for Hunting and Trapping These Animals, Also Gives Their Habits in Detail*. Columbus, OH. A.R. Harding Publishers.

Hare, Darragh., Blossey, Bernd. (2014). Principles of Public Trust Thinking, *Human Dimensions of Wildlife, 19*(5), p. 397-406.

Harris, Marvin. (1979). *Cultural Materialism*. New York. Random House.

Hawthorne, Donald. (2004). The History of Federal and Cooperative Animal Damage Control. *Sheep & Goat Research Journal, 6*.

Hazzah, L., Dolrenry, S., Naughton, S., Edwards, C. T., Mwebi, O., Kearney, F., and Frank, L (2014). Efficacy of two lion conservation programs in Maasailand, Kenya. *Conservation Biology. 28,* p. 851–860.

Henke, S., Bryant, F. C. (1999). Effects of coyote removal on the faunal community in western Texas. *Journal of Wildlife Management, 63,* p. 1066–1081.

Herfindal, Ivar., Linnell, John D. C., Moa, Pål F., Odden, John., Austmo, Lars., Andersen, Reidar. (2005). Does Recreational Hunting of Lynx Reduce Depredation Losses of Domestic Sheep? *The Journal of Wildlife Management, 69*(3), p. 1034–1042.

Hill, W.W., D.W. Hill. (1945). Navajo Coyote Tales and their Position in the Southern Athabaskan Group. *Journal of American Folklore, 58,* p.317-343.

Hilty, Jodi., Keeley, Annika T.H., Lidicker, William Z. Jr., Merenlender, Adina M. (2019). *Corridor Ecology, Second Edition: Linking Landscapes for Biodiversity Conservation and Climate Adaptation*. Island Press.

Hinton, Joseph., Heppenheimer, Elizabeth., West, Kyla M., Caudill, Danny., Karlin, Melissa L., John C. Kilgo, John Joseph Mayer, Karl V. Miller, Margaret Walch, Bridgett vonHoldt, & Michael J. Chamberlain. (2019). Geographic patterns in morphometric and genetic variation for coyote populations with emphasis on southeastern coyotes. *Ecology and Evolution*, *9*(6), 3389–3404.

Hody, J. W., & Kays, R. (2018). Mapping the expansion of coyotes (*Canis latrans*) across North and Central America. *ZooKeys, 759,* p. 81–97.

Hurley, M. A., Unsworth, J. W., Zager, P., Hebblewhite, M., Garton, E. O., Montgomery, D. M., Skalski, J. R., & Maycock, C. L. (2011). Demographic Response of Mule Deer to Experimental Reduction of Coyotes and Mountain Lions in Southeastern Idaho. *Wildlife Monographs, 1*, p. 1.

Hyde, N. (2013). *Understanding Mesoamerican Myths*. St. Catharines, Ontario. Crabtree Publishing Company.

Iossa, G., C.D. Soulsbury, P.J. Baker, and S. Harris. (2010). A taxonomic analysis of urban carnivore ecology, In: Gehrt, S.D., S.P.D. Riley, and B.L. Cypher (Eds.). *Urban Carnivores: Ecology, Conflict, and Conservation*. Baltimore. The Johns Hopkins University Press, p. 173-180.

Isenberg, A. C. (2000). *The Destruction of the Bison: An Environmental History, 1750–1920*. Cambridge University Press.

International Union for the Conservation of Nature, (IUCN). (2013). *IUCN Guidelines for Reintroductions and Other Conservation Translocations, version 1.0*. IUCN, Gland, Switzerland.

International Union for the Conservation of Nature, (IUCN). (2021). Rewilding: IUCN, Principles of rewilding. Retrieved from: https://www.iucn..org/comissions/comission-ecosystems-management-our-work/cems-thematic-groups/rewilding.

Jackson, H. H. T. (1924). Sixth annual meeting of the American Society of Mammalogists. *Journal of Mammalogy 5*, p. 218–221.

Jaeger, M. M. (2004). Selective targeting of alpha coyotes to stop sheep depredation. *Sheep & Goat Research Journal 19,* p. 80-84.

James, Edwin., Long, Stephen H.., Say, Thomas., Adams, John. (1823). *Account of an expedition from Pittsburgh to the Rocky Mountains, performed in the years 1819 and '20*. London. Longman, Hurst, Pees, Orre, & Brown.

Jefferson, Thomas. (1803). Transcript of Jefferson's letters to Meriwether Lewis. Library of Congress.

Johnston, C. S. (1938). Preliminary report on the vertebrate type locality of Cita Canyon and the description of an ancestral coyote. *American Journal of Science*, *35*(209), p. 383–390.

Kaufman, I. Burton. (2006). The *Carter Years.* The Library of American history.

Kays, R., Costello, R., Forrester, T., Baker, M. C., Parsons, A. W., Kalies, E. L., Hess, G., Millspaugh, J. J., & McShea, W. (2015). Cats are Rare Where Coyotes Roam. *Journal of Mammalogy*, *5*, p. 981.

Kays, R., Dunn, R. R., Parsons, A., Mcdonald, B., Perkins, T., Powers, S., & Shell, L. (2020). Data from: The small home ranges and large local ecological impacts of pet cats, United States.

Knowlton, F. F., Gese, E., Jaeger, M. M. (1999). Coyote depredation control: an interface between biology and management. *Journal of Range Management 52*, p. 398–412.

Knudson, T. (2012). The killing agency: Wildlife Services' brutal methods leave a trail of animal death—wildlife investigation. The Sacramento Bee. Retrieved from: https://law.lclark.edu/live/files/18171-executive-summary-investigation-of-wildlife

Koch, A., Brierley, C., Maslin, M. M., & Lewis, S. L. (2019). Earth system impacts of the European arrival and Great Dying in the Americas after 1492. *Quaternary Science Reviews, 207*, p. 13–36.

Krumm, C. E., Conner, M. M., Hobbs, N. T., Hunter, D. O., & Miller, M. W. (2010). Mountain lions prey selectively on prion-infected mule deer. *Biology Letters*, *6*(2), p. 209–211.

Kühl, Stefan. (1994). *The Nazi Connection. Eugenics, American Racism, and German National Socialism*. New York, Oxford University Press.

Lack, D (1968). "Ecological adaptations for breeding in birds". *Science*. *163*, p. 1185–1187.

Lear, Linda. (1997). *Rachel Carson: Witness for Nature*. New York. Henry Holt and Company.

Legge, S., Murphy, B. P., McGregor, H., Woinarski, J. C. Z., Augusteyn, J., Ballard, G., Baseler, M., Buckmaster, T., Dickman, C. R., Doherty, T., Edwards, G., Eyre, T., Fancourt, B. A., Ferguson, D., Forsyth, D. M., Geary, W. L., Gentle, M., Gillespie, G., Greenwood, L., & Hohnen, R. (2017). Enumerating a continental-scale threat: How many feral cats are in Australia? *Biological Conservation*, *206*, p. 293–303.

Lieberman, Bruce. (2021). Details behind Biden's '30 by 30′ U.S. lands and oceans climate goal. Yale Climate Connections. Retrieved from: https://yaleclimateconnections.org/2021/03-details-behind-bidens-30-by-30-u-us-lands-and-oceans-climate-goals/

Lewis, M., Floyd, C., Whitehouse, J., Clark, W., Thwaites, R. G., & American Philosophical Society. (1905). *Original Journals of the Lewis and Clark Expedition, 1804-1806:* Printed From the Original Manuscripts in the Library of the American Philosophical Society and by Direction of Its Committee on Historical Documents. Digital Scanning, Inc.

Leopold, A. (1919). Wild lifers vs. game farmers: a plea for democracy in sport. *Bulletin of the American Game Protective Association*, *8*, p. 6-7.

Leopold, A. (1930). Report to the American game conference on an American game policy. *Transactions of the American Game Conference*, *17*, p. 281-283.

Leopold, A. (1933). *Game management*. New York, USA. Scribners press.

Leopold, A. (1939). Conservationist in Mexico. *American Forests*, *43*, p. 118–119.

Leopold, A. (1943). A biotic view of the land. *Journal of Forestry*, *37*, p. 727–730.

Leopold, A. (1943). *Deer irruptions. Transactions of the Wisconsin Academy of Sciences, Arts, and Letters*, *35*, p. 351–366.

Leopold, A. (1944). Review of The Wolves of North America. *Journal of Forestry*, *42*, p. 928–929.

Leopold, A. (1949). *A Sand County Almanac and Sketches Here and There.* New York. Oxford University Press.

Leopold, A. S., S. A. Cain, C. M. Cottam, I. N. Gabrielson, and T. L. Kimball. (1964). *Predator and rodent control in the United States*. Wildlife Management Institute, Washington, D. C., USA.

Letnic, M., Crowther, MS. (2020). Pesticide use is linked to increased body size in a large mammalian carnivore, *Biological Journal of the Linnean Society*, *131*(1), p. 220–229.

Levi- Strauss, C. (1963). *Structural Anthropology*. New York. Basic Books.

Levi, T., Kilpatrick, A. M., Mangel M., Wilmers, C. C. (2012). Deer, predators, and the emergence of Lyme disease. *Proceedings of the National Academy of Sciences*, *27*, p. 10942–10947

Lopez, Barry. (1977). *Giving birth to Thunder, sleeping with his daughter: Coyote builds North America.* Sheed Andrews and McMeel publishing.

Loss, S., Will, T., Marra, P. (2013). The impact of free-ranging domestic cats on wildlife of the United States. *Nat Communications*, *4*, p. 1396.

Lauzon, M. (2015). Understanding Commonalities, Albert Schweitzer, and Aldo Leopold: Development of an Environmentalist Language. *Taproot Journal*, *24*(2), p. 15–20.

Mahoney, Shane, & Valerius Geist. (2019). *The North American Model of Wildlife Conservation*. Johns Hopkins University Press.

Maniscalco, Kenneth., Edens, Mary, A. (2019). Bites, Animal. StatPearls Publishing.

McManus, J., Dickman, A., Gaynor, D. (2015). Dead or alive? Comparing costs and benefits of lethal and non-lethal human wildlife conflict mitigation on livestock farms. *Oryx*, *49*, p. 687–95.

Meachen, J. A., Samuels, J. X. (2012). Evolution in coyotes (*Canis latrans*) in response to the megafaunal extinctions. *Proceedings of the National Academy of Sciences*, *109*(11), p. 4191.

Meachen,, J. A., Janowicz, A. C., Avery, J. E., Sadleir, R. W. (2014). Ecological Changes in Coyotes (*Canis latrans*) in Response to the Ice Age Megafaunal Extinctions. *PLoS ONE*, *9*, p. 12.

Mead, Margaret, Textor, Robert. (2005). *The World Ahead: An Anthropologist Anticipates the Future.* Berghahn Books.

Mech, LD. (1996). A new era for carnivore conservation. *Wildlife Society Bulletin*, *24*: p. 397–401.

Mech LD. (1999). Alpha status, dominance, and division of labor in wolf packs. *Canadian Journal of Zoology*, *77*, p. 1196–1203.

Mech, L. David., Boitani, Luigi. (2006). *Wolves: Behavior, Ecology, and Conservation*. University of Chicago Press

Mech, L. D. (2017). Where can wolves live and how can we live with them? *Biology Conservation. 210*, p. 310–317.

Meine, Curt D., and Knight, Richard. (2006). *The Essential Aldo Leopold: Quotations and Commentaries.* University of Wisconsin Press.

Merriam, C. H. (1897). Revision of the coyotes or prairie wolves, with descriptions of new forms. *Proceedings of the Biological Society of Washington*, *11*, p. 19–33.

Micke, Heinrich., Wolf, Hans. (2000). Thallium and Thallium Compounds. *Ullmann's Encyclopedia of Industrial Chemistry*. Weinheim: Wiley-VCH.

Miranda, E. B. P., Menezes, J. F. S., Farias, C. C. L., Munn, C., & Peres, C. A. (2019). Species distribution modeling reveals strongholds and potential reintroduction areas for the world's largest eagle. *PLoS ONE*, *14*(5), p. 1–19.

Monroy, V. O., Gonzalez, M.J.F., Balbuena S.A., Elvir , F., Zarco, G. M. M., & Rodriguez, S. C. (2020). Coyote (*Canis latrans*) in South America: potential routes of colonization. *Integrative Zoology*, *15*(6), p. 471–481.

Morgan, Lewis H. (1868). *The American Beaver and his Works*. J. B. Lippincott & Co.1

Mosley, J. C., Roeder, B. L., Frost, R. A., Wells, S. L., McNew, L. B., & Clark, P. E. (2020). Mitigating Human Conflicts with Livestock Guardian Dogs in Extensive Sheep Grazing Systems. *Rangeland Ecology & Management, 73*(5), p. 724–732.

Mowry, Christopher, B., Wilson, Lawrence, A. (2019). Species richness in an urban coyote habitat in Atlanta, Georgia. *Urban Naturalist, 27*, p. 1-14.

Mowry, Christopher, B., Adel, Lee., Taylor, Zachary P., Hamid, Nadeem., Whitney, Shannon., Heneghen, Michael., Russell, James., & Wilson, Lawrence A. (2020). Using community science data to investigate urban Coyotes (*Canis latrans*) in Atlanta, Georgia, USA, *Human Dimensions of Wildlife*, *26*(2), p.163-178.

Munthe, Kathleen. (1998). Chapter 7, Canidae. In Janis, C.M.; Scott, K.M.; Jacobs, L.L. (eds.). *Evolution of Tertiary Mammals of North America.* New York, NY: Cambridge University Press. p. 124–143.

Naiman, Robert J.; Johnston, Carol A. & Kelley, James C. (1988). Alteration of North American Streams by Beaver. *BioScience. 38*(11), p. 753–762.

National Park Service, (NPS). (2020). Gray Wolf - YellowStone National Park. U.S. National Park Service. Retrieved from: https://www.nps.gov/yell/learn/nature/wolves.htm

National Park Service, (NPS). (2021). Elk - YellowStone National Park, U.S. National Park Service. Retrieved from: https://www.nps.gov/yell/learn/nature/elk.htm.

Nelson, Michael P., Vucetich, John., Paquet, Paul., Bump, Joseph. (2011). An Inadequate Construct? North American Model: What's Flawed, What's Missing, What's Needed. *The Wildlife Professional*, p. 58–60.

Nelson, P., Vucetich, A. (2014). Wolf Hunting and the Ethics of Predator Control. *Oxford Handbook of Animal Studies*. Oxford University Press.

Nogales, Manuel., Vidal, Eric. (2013). Feral Cats and Biodiversity Conservation: The Urgent Prioritization of Island Management. *Journal of BioScience. 63*(10), p. 804–810.

The Northwestern Band of the Shoshone Nation. (2005). *Coyote Steals Fire: A Shoshone Tale*. University Press of Colorado.

Nowak, R. M. (1978). "Evolution and taxonomy of coyotes and related *Canis*", in M. Bekoff (ed.) *Coyotes: Biology, Behavior, and Management*. New York. Academic Press, p. 3–16.

Nowak, R. (1992). Wolves: The great travelers of evolution. *International Wolf, 2*. p. 3–7.

Nowak, R.M. (2003). Chapter 9 - Wolf evolution and taxonomy. In Mech, L. David; Boitani, Luigi (eds.). Wolves: Behaviour, Ecology and Conservation. University of Chicago Press, p. 239–258.

Opler, Morris. (1938). *Myths and Tales of the Jicarilla Apache Indians*. New York. Society of American Folklore. Kraus Reprint Co.

Organ, John., Mahoney, Shane. (2007). The Future of Public Trust. *The Wildlife Professional*, p. 18–22.

Organ, J.F., Geist, V., Mahoney, S., Williams, S., Krausman, P.R., Batcheller, B., Decker, T.A., Carmichael, R. Nanjappa, p., Regan, R., Medellin, R., Cantu, R.E., McCabe, S., Craven, S., Vecellio, G.M., Decker, D.J. (2012). *The North American Model of Wildlife Conservation*. The Wildlife Society. *The Wildlife Society Technical Review*, p. 12-04.

Osland, A., & Clinch, N. (2013). Stakeholder Dialogue: Alley Cat Allies & Us Fish and Wildlife Service. *Journal of Critical Incidents*, *6*, p. 133–136.

Ostfeld, Richard S., Jones, Clive G., Wolff, Jerry O. (1996). Of Mice and Mast. *BioScience*. *46*(5), p. 323.

Ostfeld Richard S., Levi Taal, Keesing Felicia, Oggenfuss Kelly, & Canham Charles D. (2018). Tick-borne disease risk in a forest food web. *Ecology*, *99*(7), p. 1562–1573.

Ovenden, T. S., Palmer, S. C. F., Travis, J. M. J., & Healey, J. R. (2019). Improving reintroduction success in large carnivores through individual-based modelling: How to reintroduce Eurasian lynx (*Lynx lynx*) to Scotland. *Biological Conservation, 234*, p. 140–153.

Paine, R. (1966). Food Web Complexity and Species Diversity. *The American Naturalist, 100*(910), p. 65-75.

Peebles, K., Wielgus R. B., Maletzke, B. T., Swanson, M. E. (2013). Effects of remedial sport hunting on cougar complaints and livestock depredations. *PLoS ONE 8:* e79713.

Peterson, M. N., & Nelson, M. P. (2017). Why the North American Model of Wildlife Conservation is Problematic for Modern Wildlife Management. *Human Dimensions of Wildlife*, *22*(1), p. 43–54.

Pierotti, Raymond., Fogg, Brandy. (2017). *The First Domestication: How Wolves and Humans Coevolved*. Yale University Press.

Pimm, S. L., Jenkins, C. N., Abell, R., Brooks, T. M., Gittleman, J. L., Joppa, L. N., Raven, P. H., Roberts, C. M., Sexton, J. O. (2014). "The biodiversity of species and their rates of extinction, distribution, and protection" (PDF). *Science*, *344*(6187), p. 1246752.

Powers, Stephen. (1877). *Tribes of California*. Washington: Contributions to North American Ethnology.

Prugh, L. R., Arthur, S. (2015). Optimal predator management for mountain sheep conservation depends on the strength of mesopredator release. *Oikos*, *124*, p.1241–1250.

Rasmussen, D. Irwin (1941). Biotic Communities of Kaibab Plateau, Arizona. Ecological Monographs. Hoboken, New Jersey: *Wiley*, *11*(3), p. 229–275.

Reichard, Gladys. (1947). *An Analysis of Coeur D'Alene Indian Myths*. Society of American Folklore. New York, Kraus Reprint.

Reichard, U.H. (2002). Monogamy—A variable relationship. *Max Planck Research. 3*, p. 62–7.

Reiger, John F. (2001). *American Sportsmen and the Origins of Conservation* (Third ed.). Oregon State University Press. p. 4.

Rewilding Europe. (2021). Wildlife comeback, Rewilding Europe, 2021. Retrieved from: https://rewildingeurope.com/rewilding-in-action/wildlife-comeback/.

Richards, H. (1999). Beyond Silent Spring: Integrated Pest Management and Chemical Safety. Edited by H.F. van Emden and D.B. Peakall. *Integrated Pest Management Reviews*, *4*(3), p. 269–270.

Ripple, W., Beschtal, R. (2005). Linking Wolves and Plants: Aldo Leopold on Trophic Cascades. BioScience, *American Institute of Biological Sciences, 55*(7), p. 613-621.

Ripple, W. J., Beschta, R. L. (2012). Trophic cascades in YellowStone: the first 15 years after wolf reintroduction. *Biological Conservation 145*(1), p. 205–213.

Ripple, J. William., Estes, James, A., Beschta, Robert, L., Wilmers, Christopher, C., Ritchie, Euan, G., Hebblewhite, Mark., Berger, Joel., Elmhagen, Bodil., Letnic, Mike., Nelson, Michael, P., Schmitz, Oswald, J., Smith, Douglas, W., Wallach, Arian, D., Wirsing, Aaron, J. (2014). Status and Ecological Effects of the World's Largest Carnivores. *Science*, *343*(6167), p. 151.

Ripple, W. J., Beschta, R. L., Fortin, J. K., Robbins, C. T. (2014). Trophic cascades from wolves to grizzly bears in YellowStone. *Journal of Animal Ecology, 83*(1), p. 223–233.

Ritters, K., Wickham, J., Costanza, J., Vogt, P. (2016). A global evaluation of forest interior area dynamics using tree cover data from 2000 to 2012. *Landscape Ecology*, *31*(1), p. 137–148.

Rogers, C., Caro, M. J. (1998). Song Sparrows, Top Carnivores and Nest Predation: A Test of the Mesopredator Release Hypothesis. *Oecologia, 116*(1/2), p. 227-233.

Rosenberg, K. V., Dokter, A. M., Blancher, P. J., Sauer, J. R., Smith, A. C., Smith, P. A., Stanton, J. C., Panjabi, A., Helft, L., Parr, M., Marra, P. P. (2019). Decline of the North American avifauna. *Science*, *366*(6461), p. 120–124.

Roosevelt, T., Hagedorn, H. (1914). Twisted eugenics. *The Outlook*, *106*, p. 30-34.

Sacks, B. N., Jaeger, M. M., Neale, J. C., McCullough, M. (1999). Territoriality and breeding status of coyotes relative to sheep predation. *The Journal of Wild- life Management*, *63*, p. 593-605.

Sanderson, Eric W., Beckmann, Jon P., Beie, Paul r, Bird, Bryan, Juan Carlos Bravo, Kim Fisher, Melissa M. Grigione, Carlos A. López González, Jennifer R. B. Miller, Cristina Mormorunni, Laura Paulson, Rob Peters, John Polisar, Tony Povilitis, Michael J. Robinson, & Sharon Wilcox. (2021). The case for reintroduction: The jaguar (*Panthera onca*) in the United States as a model. *Conservation Science and Practice*, *3*(6).

Sepkoski, D. (2021). The Anthropocene Is Overrated. *Foreign Policy*, *99*(240), p. 71–75.

Saville, M. H. (1899). Codex Borbonicus. *Science*, *9*(230) p. 746–747.

Schmidly, D. J., Bailey, V. (2018). *Vernon Bailey: Writings of a Field Naturalist on the Frontier*. Texas A&M University Press.

Schorger, A. W. (1955). *The Passenger Pigeon: Its Natural History and Extinction*. Madison, Wisconsin. University of Wisconsin Press.

Shipman, Pat. (2015). *The Invaders: How Humans and Their Dogs Drove Neanderthals to Extinction*. Harvard University Press.

Shivik, J. A., A. Treves, P. Callahan. (2003). Non-lethal techniques for managing predation: primary and secondary repellents. *Conservation Biology, 17*(6), p. 1531- 37.

Shivik, J. A. (2015). *The predator paradox: Ending the war with wolves, bears, cougars, and coyotes*. Boston. Beacon Press.

Sih A., Crowley, P., McPeek, M., Petranka, J., Strohmeier, K. (1985). Predation, competition, and prey communities: a review of field experiments. *Annual Review of Ecology and Systematics, 16*, p. 269–311.

Simmons, R. T., Sim, K., & Yonk, R. M. (2016). *Nature Unbound: Bureaucracy Vs. The Environment*. Independent Institute Press.

Slagle, K., Bruskotter, J. T., Singh, A. S., and Schmidt, R. H. (2017). Attitudes toward predator control in the United States: 1995 and 2014. *Journal of Mammalogy, 98*(1), p. 7–16.

Snyder, Noel. (2004). *The Carolina Parakeet: Glimpses of a Vanished Bird*. Princeton University Press.

Spence, Mark (1999). *Dispossessing the Wilderness: Indian Removal and the Making of the National Parks*. New York. Oxford University. p. 55–70.

Spranz, Bodo. (1975). *Fondo de Cultura Económica México. Los Dioses en los Códices Mexicanos del Grupo Borgia: Una Investigación Iconográfica*. University of México press.

Sotnikova, M. (2010). Dispersal of the Canini (Mammalia, Canidae: Caninae) across Eurasia during the Late Miocene to Early Pleistocene. *Quaternary International. 212*(2), p. 86–97.

Soulé, M. E. (1985). What is conservation biology? *BioScience 35*(11*)*, p. 727–734.

Soulé´ M.E., Bolger, D.T., Alberts, A.C., Wrights, J., Sorice, M., Hill, S. (1988). Reconstructed dynamics of rapid extinctions of chaparral requiring birds in urban habitat islands. *Conservation Biology 2*, p. 75–92.

South Carolina Department of Natural Resources, (SCDNR). (2009). SCDNR - Wildlife Information. Deer population and natural history bulletin. Retrieved from: https://www.dnr.sc.gov/wildlife/deer/2009DeerAntlerRecords.

South Carolina Department of Natural Resources, (SCDNR). (2019). Bill 489: Coyote bounty program - South Carolina Legislature Online. Retrieved from: https://www.scstatehouse.gov/sess123-2019-2020/bills489.htm

Sovada, M., Sargeant, A., Grier, J. (1995). Differential Effects of Coyotes and Red Foxes on Duck Nest Success. *The Journal of Wildlife Management, 59*(1), 1-9.

Spiro, Jonathan. (2009). *Defending the master race: Conservation, eugenics, and the legacy of Madison Grant*. University of Vermont Press. p. 97

Stanley, S.D. (1917). *Personal Memoirs of Major-General D.S Stanley.* U. S. A. Cambridge, Mass, Harvard University Press.

Stennes, Katie (2018). Notes From the Field: Carnivore Coexistence Lab ~ Interview with Dr. Adrian Treves Katie. Retrieved from: https://www.projectcoyote.org/carnivore-lab-dr-adrian-treves.

Stephenson T. R. (2012). *2010–2011 annual report of the Sierra Nevada bighorn sheep recovery program: a decade in review*. California Department of Fish and Game. Bishop, California.

Stone, S. A. (2009). "Compensation and Non-lethal deterrent programs: building tolerance for wolf restoration in the Rockies," *A New Era for Wolves and People: Wolf Recovery, Human Attitudes and Policy. Energy, Ecology and Environment Series*. No. 2, eds L. Boitani, P. C. Paquet, and M. Musiani. Calgary. University of Calgary Press.

Stone, S.A., Breck, Stewart, W., Timberlake, Jesse., Haswell, Peter, M., Najera, Fernando., Bean, Brian S., Thornhill, Daniel, J. (2017). Adaptive use of nonlethal strategies for reducing wolf-sheep conflict in Idaho. *Journal of Mammalogy*, *8*(1), p. 33-44.

Strickland, M. S., Hawlena, D., Reese, A., Bradford, M. A., Schmitz, O. J. (2013). Trophic cascade alters ecosystem carbon exchange. *Proceedings of the National Academy of Sciences of the United States of America*, *110*(27), p. 11035-11038.

Tallman, Dan A., D.L. Swanson, and J.S. Palmer, eds. (2002). *Birds of South Dakota*. The South Dakota Ornithologist's Union. Aberdeen, South Dakota. Quality Quick Print Press.

Taylor, D. T., Rashford, B. S., Coupal, R. H., Foulke, T. (2009). An economic analysis of predator management in Wyoming. Final report to Wyoming Animal Damage Management Board, Wyoming Department of Agriculture. p. 69.

Teit, James. (1917). *Folktales of Salishan and Sahaptin Tribes*. New York: Houghton Mifflin. p. 1-18.

Tedford, Richard H., Wang, Xiaoming; Taylor, Beryl E. (2009). Phylogenetic Systematics of the North American Fossil Caninae (Carnivora: Canidae). *Bulletin of the American Museum of Natural History*, *325*, p. 1–218.

Tortato, F. R., Izzo, T. J., Hoogesteijn, R., & Peres, C. A. (2017). The numbers of the beast: valuation of jaguar (*Panthera onca*) tourism and cattle depredation in the Brazilian Pantanal. *Global Ecology and Conservation*, *11*, p. 106–114.

Treves, A., Naughton-Treves, L. (2005). Evaluating lethal control in the management of human–wildlife conflict. In R. Woodroffe, S. Thirgood, & A. Rabinowitz (Eds.), *People and Wildlife, Conflict or Co-existence?* Cambridge. Cambridge University Press. *Conservation Biology*, p. 86-106.

Treves, A. (2009). The human dimensions of conflicts with wildlife around protected areas. Washington, DC. Island Press. *Wildlife and Society: The Science of Human Dimensions*, p. 214–228.

Treves, A., Naughton-Treves, L., and Shelley, V. (2013). Longitudinal analysis of attitudes towards wolves. *Conservation Biology 27*(2), p. 315–323.

Treves, A., M. Krofel, J. McManus. (2016). Predator control should not be a shot in the dark. *Frontiers in Ecology and the Environment 14*(7), p. 380–388.

Treves, A., Chapron, G., López-Bao, J. V., Shoemaker, C., Goeckner, A. R., & Bruskotter, J. T. (2017). Predators and the public trust. *Biological Reviews*, *92*(1), p. 248–270.

Treves, A., Artelle, K. A., & Paquet, P. C. (2019). Differentiating between regulation and hunting as conservation interventions. *Conservation Biology: The Journal of the Society for Conservation Biology*, *33*(2), p. 472–475.

Trouwborst, Arie Phillipa C. McCormack, & Elvira Martínez Camacho. (2020). Domestic cats and their impacts on biodiversity: A blind spot in the application of nature conservation law. *People and Nature, 2*(1), p. 235–250.

UNC-Akçakaya, H. R., Bennett, E. L., Brooks, T. M., Grace, M. K., Heath, A., Hedges, S., Young, R. P. (2018). Quantifying species recovery and conservation success to develop an IUCN Green List of Species. *Conservation Biology*, *32*(5), p. 1128–1138.

United Nations (UN). (2009). *World Population Prospects: The 2008 Revision*. United Nations Publications.

United Nations (UN). (2021). The UN Decade on Restoration. Retrieved from: https://www.decadeonrestoration.org

United Nations (UN). (2021). Rewilding sees jaguars return to Argentina's wetlands. (UNep.org, 2021). Retrieved from: https://www.unep.org/news-and-stories/story/rewilding-sees-jaguars-return-argentinas-wetlands.

United States Department of Agriculture (USDA). (2016). *Overview of United States Cattle Industry*. Washington DC. USDA National Agriculture Statistics Service.

United States Fish and Wildlife Services (USFWS). (2016). Hunter Survey 2016. Retrieved from: https://www.fws.gov/wsfrprograms/subpages/nationalsurvey/natsurvey2016.pdf

United States Geological Survey (USGS). (2018). Gap Analysis Project (GAP). Protected Areas Database of the United States (PAD-US): U.S. Geological Survey data release.

United States Department of Agriculture Animal & Plant Health Inspection Service Wildlife Services (USDA APHIS). (2020). Coyote Ecology and Damage Management. Retrieved from:

https://www.aphis.usda.gov/wildlife_damage/reports/Wildlife%20Damage%20Management%20Technical%20Series/coyotes-wdm-technical-series.pdf

United States Department of Agriculture Animal & Plant Health Inspection Service Wildlife Services (USDA APHIS). (2020). USDA APHIS 1996- 2020 Program Data Reports. Retrieved from: https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/sa_reports/sa_pdrs/?fy=2017&fld=&fld_val=.

United States Fish and Wildlife Services (USFWS). (2021). Hunters as Conservationists. U.S. Fish and Wildlife Service (fws.gov). Retrieved from: httsp://www.fws./refuges/hunting-hunters/as-conservationists

United States Fish and Wildlife Services (USFWS). (2021). Wildlife Management Timeline. Retrieved from: https://www.fws.gov/refuges/history/historical-timeline.html

United States National Archives Catalog. (2021). Retrieved from: https://www.catalog.archives.gov/

Vaclav, Smil. (2011). Harvesting the Biosphere: The Human Impact. *Population and Development Review*, *37*(4), p. 613.

Von Holdt, B. M., Kays, R., Pollinger, J. P., Wayne, R. K. (2016). Admixture mapping identifies introgressed genomic regions in North American canids. *Molecular Ecology, 25*(11), p. 2443–2453.

Vucetich, J. A., Bruskotter, J. T., Nelson, M. P. (2015). Evaluating whether nature's intrinsic value is an axiom of or anathema to conservation. *Conservation Biology*, *29*, p. 321–332.

Vucetich J. A., Bruskotter J. T., Nelson M. P., Peterson R. O., Bump J. K. (2017). The principles of wildlife management and wolf harvesting in Michigan. *Journal of Mammalogy*.

Waldmann, Lu, Y., N., Nadel, D., Marco, S. (2017). Increased sedimentation following the Neolithic Revolution in the Southern Levant. *Global & Planetary Change, 152*, p. 199–208.

Wallach, A. D., Ritchie, E. G., Read, J., O'Neill, A. J. (2009). More than Mere Numbers: The Impact of Lethal Control on the Social Stability of a Top-Order Predator. *PLoS ONE, 4*(9), p. 1–8.

Wallach, A. D., Johnson, C. N., Ritchie, E. G., O'Neil, A. J. (2010). Predator control promotes invasive dominated ecological states. *Ecology Letters*, *13*(8), p. 1008–1018.

Wallach, A. D., Bekoff, M., Nelson, M. P., Ramp, D. (2015). Promoting predators and compassionate conservation. *Conservation Biology, 29*(5), p. 1481–1484.

Wallach A. D., Ramp D., O'Neill, A. J. (2017). Cattle mortality on a predator- friendly station in central Australia. *Journal of Mammalogy, 98*(4), p. 33-34.

Waltmann, Henry G. (1971). Circumstantial Reformer: President Grant and the Indian Problem. *Arizona and the West, 13*(4), p. 323-342.

Wang, X. (1994). Phylogenetic systematics of the Hesperocyoninae (Carnivora: Canidae). *Bulletin of the American Museum of Natural History, 221*, p. 1-207.

Wang, X., Tedford, Richard. (2008). *Dogs: Their Fossil Relatives and Evolutionary History*. New York. Columbia University Press.

WBTV News. (2019). Pile of 70 dead coyotes found near NC neighborhood, Samson Parker interview. WBTV News. North Carolina Regional News. Retrieved from: https://www.wbtv.com/newsstate-regional-news/pile-of-70-dead-coyotes-found-near-nc-neighborhood.

Weston, Phoebe., Greenfield, Patrick. (2018). World must rewild on a massive scale to heal nature and climate. The Guardian. Retrieved from: https://www.theguardian.com/environment/2021/jun/03/rewilding-on-massive-scale-to-heal-climate-and-nature-says-un--decade-on-restoration-aoe

Wielgus R.B., Peebles, K. (2014). Effects of wolf mortality on livestock depredations. *PLoS ONE*, *9*(12), e113505.

Wilkinson, Todd. (2018). Hunting faces an ethical reckoning. High Country News. Retrieved from: https://www.hc.org/articles-hunting-faces-an-ethical-reckoning

Wilmers, C. C., Metz, M. C., Stahler, D. R., Kohl, M. T., Geremia, C., Smith, D. W., & Dantzer, B. (2020). How climate impacts the composition of wolf-killed elk in northern YellowStone National Park. *Journal of Animal Ecology*, *89*(6), p. 1511–1519.

Wurth, A. M., Ellington, E. H., Gehrt, S. D. (2020). Golf Courses as Potential Habitat for Urban Coyotes. *Wildlife Society Bulletin*, *44*(2), p. 333–341.

Wyoming Game and Fish Department (WGFD). (2020). Wyoming state hunting and harvesting regulations. Retrieved from: https://wgfd.wyo.gov/Regulations/RegulationPDFs/REGULATIONS_CH47_BROCHURE.pdf.

Zeidler, D. L., Sadler, T. D. (2000). *Bad Science and Its Social Implications:* Historical Perspectives.