

Thank goodness they got all the dragons: wildlife damage management through the ages

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Abstract: Whenever the needs both of humans and wildlife overlap, there is a potential for wildlife damage to occur. Wildlife damage has been an issue throughout human history. Typical history essays about wildlife damage management (WDM) examine a chronology of events on the topic. This paper takes a different approach. Looking through the history of WDM, we considered the driving factors behind changes in the management of wildlife damage. Based on the events of WDM history, we defined 4 factors that underlie major shifts in the management of wildlife damage: human population needs, economic stability, social paradigms, and tools and techniques. To illustrate how these factors affect WDM, we first explained their interplay using the example of knights and dragons. We then considered how these factors changed throughout actual human history by subdividing history into 6 time periods of WDM. We found that managers' tactics for dealing with wildlife damage do matter; understanding the factors that affect management is important for wildlife damage managers to handle future challenges.

Key words: history, human–wildlife interactions, wildlife conflicts, wildlife damage management

THE HISTORY OF WILDLIFE damage management (WDM) extends to prehistoric times. Whenever human needs and wildlife needs overlap, there is a potential for damage to occur. However, throughout history, people have responded differently to wildlife damage. We propose that changes in WDM throughout history are primarily driven by 4 factors: human population needs, economic stability, social paradigms, and tools and techniques. The 2 human population needs that most commonly bring people into conflict with wildlife are food and safety. Economic stability affects society's tolerance for damage; societies are generally more tolerant of damage in times of plenty than in times of need. Social paradigms are largely driven by whether human needs are being met and by economic stability (or lack thereof). However, some overall trends in social paradigms have developed in recent history. Finally, while changes in tools and techniques throughout history are interesting to observe, they are not typically drivers of change in the management of wildlife damage. Instead, they represent how managers can respond to wildlife damage within the context of the other 3 factors. This paper examines 6 time periods of WDM from prehistoric to modern times. Within each time period we use the four factors to characterize WDM during that time period and explain how those characteristics arose.

A fire-breathing example

“The Knights of the Round Table may have been the world's first professional NWCOS (nuisance wildlife control operators). After all, they were the ones who were always called upon when there was trouble with fire-breathing dragons.” *Anonymous*

Before exploring actual human history, we will begin with an example that plays off this quote to explain the 4 factors of WDM. In the time of dragons, food and safety were relatively scarce. Dragons posed a huge threat to both of these human needs, burning down entire wheat fields with one angry breath, stealing sheep and other livestock, and occasionally posing a direct threat to human lives. Tolerance for this sort of wildlife damage was quite low. During a particularly good year, when crops and livestock were plentiful, peasants did not worry if one small dragon took a few sheep. But during lean times or at times when villagers were defending themselves from foreign invaders, every sheep was precious, and each grain of wheat was valuable. People living in the time of dragons had a utilitarian view of nature and wildlife. “Good” animals included livestock, deer, and fish; these animals could be used to benefit individuals and their families. “Bad” animals included wolves (*Canis lupus*),

blackbirds (Icteridae), and most certainly dragons, which threatened people, their resources, or both. Knights used the tools they had available to fight dragons, which posed such a great threat that the villagers approved of any possible means of killing them. As technology improved, knights' tools became more advanced and therefore more effective.

Management of dragon damage was a no-nonsense operation. Peasants, who were frequently hungry, tired, and scared, did not worry about the role of dragons in the local ecosystem. Eradication was the goal of dragon management from the beginning. Obviously, the knights were quite effective in their quest to end the terror of dragons. When the last dragon was slain, the people and the knights cheered, for the goal had been accomplished. But later that year, on a warm, peaceful harvest evening, the knight who slew the last dragon sighed, for he had seen a green fire in the dying dragon's eyes.

Time periods in the history of WDM

Prehistoric: pre-3500 B.C.

The prehistoric time period is characterized by the pre-agriculture organization of human societies. Agricultural practices developed and spread at different rates in civilizations around the world. Thus, 3500 B.C. is not an exact date for this period (Descartes 2010). But before the advent of agriculture, human societies had a fundamentally different approach to WDM. Hunter-gatherer societies held an integrated, utilitarian view of nature and wildlife. Although today humans are not typically considered objects of prey, humans in the prehistoric period were an integral part of the local food chain. Therefore, the main WDM goal during the prehistoric time period was reduction of predator populations that threatened both food supply and safety of early humans. Humans relied on the same prey for food as did predators, so fewer predators meant less competition. Furthermore, humans themselves were prey; so, reduction of predators decreased the threat to human lives.

Economic stability had relatively little impact on WDM during this period, as hunter-gatherer populations frequently were nomadic and

inherently fluctuating. However, damage likely occurred more often in years of scarcity, due to increased competition between humans and animals for limited resources. Improvements in the management tools used throughout this period greatly increased the effectiveness of prehistoric WDM. Tools, fire, and cooperative hunting enabled early societies to attain the food they needed and reduced the risk of becoming food for a predator.

Ancient–Medieval: 3500 B.C. to A.D. 1607

With the spread of agriculture, humans began to see their food as separate from that of local wildlife. This new viewpoint separates prehistoric WDM from ancient–medieval WDM. Agriculture provided great stability for human societies by providing a more reliable food source, but humans were not the only ones to benefit. Animals also found crops to be a dependable food source and took advantage of the sudden ripening of a large amount of food all in one convenient location. Protecting the fruits of harvest from wildlife was a significant WDM problem during the ancient–medieval time period. This hard-earned food source had to be protected both during the growing season and after the harvest, so reducing wildlife damage became a significant task.

Just as agriculture benefitted society by allowing people to remain in one place, it also increased human safety, because societies built more stable and permanent shelters. However, predators were still occasionally a threat to human safety and also posed a threat to livestock; so, tolerance of predators remained low. Despite the increased economic stability of an agricultural society, communities were still susceptible to the effects of drought, flood, and other natural disasters. Any natural disaster that reduced food supplies subsequently decreased tolerance for wildlife damage. Additionally, considerable economic fluctuations occurred. Depending on changes in government, wars, relationships with neighboring countries and territories, and the organization of social classes, the stability of a region could vary from secure to volatile. War and turmoil reduced tolerance for wildlife damage because the protection of lives, properties, and resources became the highest priority.

During this period, animals were still classified as good or bad. The representative animals in each category were largely the same species as in the prehistoric period. Because of the new viewpoint that animals and their food were separate from people and their food, we call this period's paradigm "detached utilitarian."

Although we grouped ancient and medieval time periods based on their similarity in 3 of the 4 factors, a distinguishing difference is the use of tools and technology. In ancient times, humans mainly used themselves as tools to mitigate wildlife damage (Conover 2001). Children, for example, were commonly sent into the fields to scare away birds, and shepherds guarded sheep from predators. Scarecrows also were used, providing the likeness of a person in lieu of actual human presence. The use of domestic cats to protect harvested grain from rodents was one notable exception to this rule, as was the use of sulfur as a fungicide to protect crops. In medieval times, toxicants and other tools expanded the methods available to address wildlife damage (Conover 2001). Important toxic plants used in WDM included hemlock, oleander, and wolfsbane. Ground glass mixed into honey made a toxic attractant for control of rodents. Nets helped farmers reduce bird damage, while rodent control was aided by the development of several types of traps, including snap, deadfall, and mill traps. An ineffective method of WDM explored during the medieval time period was "rat letters", i.e., notes that kindly asked rats to leave a residence and move to another location. These letters were left in areas where rats could find them, read them, and possibly be persuaded to heed the request (Fitzwater 1990).

Colonial and Frontier America: 1607 to 1890

This time period begins in 1607 with the settlement of Jamestown, the first permanent English settlement in America. While cities and economies grew in Europe, settlers arriving in America lacked such stability. Instead, colonial and frontier America were characterized by the constant risk of starvation. To protect their crops, livestock, and families in the New World, many colonists adopted Native American techniques

for managing wildlife damage. For instance, farmers erected platforms in agricultural fields so children could throw stones at birds (Conover 2001). Reduction of predator populations through hunting was already common among native peoples. However, the paradigms and tools that colonists brought to America set colonial and frontier WDM apart from that of native peoples and the previous time period.

Although colonists and frontiersmen classified animals as good and bad, their view of nature was not utilitarian. The paradigm of this time period is better described as manifest destiny, i.e., beyond controlling bad wildlife, colonists desired to eliminate injurious species and believed that taming the wilderness was a possible and even laudable task. Tools such as firearms increased the efficacy with which colonists could reduce populations of nuisance wildlife. In addition to tools, though, the colonists' actions were spurred by the motivation of bounties (Lund 1976, Conover 2001). Some colonial governments offered bounties for predators and nuisance birds, including blackbirds (Icteridae), crows (*Corvus* spp.), and passenger pigeons (*Ectopistes migratorius*). As populations of these animals decreased, bounties were increased to encourage their eradication (Conover 2001).

Looking back on early American WDM, one may find it easy to criticize the actions and goals of the colonists. However, it is important to remember how all 4 factors affected this time period. Starvation was a very real prospect each day for colonists and for those who set out into the American frontier. Market hunting arose as a way to boost the economy and provide stability to people living in the New World. Americans had products not available in Europe, and colonists took advantage of this opportunity to increase the standing of their new country. Many people who settled America were fleeing religious persecution and believed that their destiny was to tame the new land. New tools and motivations pushed settlers to pursue their goals and this destiny. While today's managers and wildlife enthusiasts may criticize the mistakes made in this time period, economic changes would soon lead Americans to question their own WDM.

Industrial Revolution: 1890 to 1914

The Industrial Revolution began prior to 1890, but this date marks the coincidence with a particular event that caused Americans to reflect on the views and actions of an earlier time—closing of the American frontier. The Industrial Revolution in America allowed human needs to be met on a broader scale than ever before. Increased, efficient production of food nourished many people, who felt safe from predators as they moved into cities. The economy boomed with newly created jobs. When the American frontier was declared closed, economic stability combined with plentiful resources gave Americans a chance to pause and consider what had been lost in the previous time period. At the same time, dangerous working conditions, polluted city air, and other problems of urban life caused people to reconsider their new “progress” (Conover 2001). Many people felt nostalgia for the lost and damaged wilderness. New awareness of the importance of wildlife and wild places characterized WDM in the industrial period.

Two main paradigms arose during this period. While not entirely contradictory, the paradigms differ in their valuation of nature and wildlife. The first paradigm was conservation. Conservationists, including Theodore Roosevelt and Gifford Pinchot, promoted sustainable use and management of natural resources (Callicott 2000). The conservationist paradigm advocated responsible take of wildlife and promoted fair chase and other standards of ethical hunting. Conservationists sought to manage wildlife populations so that there would be a surplus of game to be hunted. In particular, the conservation paradigm encouraged management of “good” species, slightly redefined from earlier time periods to include any species that could be hunted. Protection of nongame animals, including reptiles, amphibians, and many species of birds, was not explicit in hunting-based conservation, but conservation of game animals benefited other species, as well. The second paradigm of the industrial period was the preservationist viewpoint. Preservationists such as John Muir argued that nature and wildlife should be protected for their own sake; they promoted spiritual and intrinsic values of nature (Callicott 2000). Both viewpoints helped turn American

consciousness toward an awareness of the threats to wilderness and wildlife, as well as the damage that had already been done.

On a stable economic basis, enlightened by new paradigms, WDM in the industrial period began to emerge as a profession. In 1885, C. Hart Merriam conducted the first surveys on bird damage in agricultural fields (Timm 2000, Hawthorne 2004, Miller 2007). He received money from Congress to analyze his data, and WDM as a science was born. In light of America’s new viewpoints on the natural world, the work of Merriam and others began to elevate the status of WDM. Unlike other periods where the majority of the population faced wildlife damage and dealt with it themselves, the movement of people into cities during this and subsequent periods meant that fewer people practiced WDM on a daily basis. Instead, they began to look to managers with specific experience to help with their wildlife problems.

Great Depression and world wars: 1914 to 1945

The new take on WDM during the industrial period brought changes across America prior to 1914. Progress halted, however, in light of the turmoil caused by World War I. Increased foreign tensions and concerns about the war substantially decreased tolerance of wildlife damage. The first substantial Congressional appropriations for predator control were made in 1915 and then increased during the war (Miller 2007). Although World War I ended just 2 years after the push for increased predator control, the Great Depression quickly followed. The basic needs of America’s people—and other people around the world—were no longer being met. Food shortages and high prices left many people hungry. When World War II began, people around the world felt unsafe due to international instability and the threat (or reality) of military attacks.

In America, the main paradigm of WDM reverted to utilitarianism. Some lessons carried over from the previous period; most people no longer sought to eliminate injurious species. But due to limited resources, threats to safety, and economic instability, people accepted any necessary means used by managers to control nuisance wildlife.

Modern America: 1945 to present

In stark contrast to earlier conditions, America's economy surged after World War II. Americans' needs were abundantly satisfied, with plenty of food, safety, and even leisure time enjoyed by many people. The population increased, as did urbanization. More people than ever before lived in cities and sprawling suburbs. Open space and wilderness were reduced, accompanied by diversification of land use.

Overall, tolerance for wildlife damage increased as a result of economic stability and widespread prosperity. However, a new paradigm split developed between people living in cities and those living in rural areas. People in rural areas commonly held a commodity interest in natural resources, similar to the conservationist values of the industrial period. For these rural residents, WDM was an integral part of daily life. Urban residents' lives were more separated from traditional wildlife damage (such as damage to crops and livestock). While urban residents did deal with wildlife damage (especially as urban areas expanded and wildlife populations adapted to these new habitats), urban wildlife damage typically did not threaten residents' livelihoods. Urban residents were therefore more likely to have environmental interests that are similar to preservationist beliefs. These 2 viewpoints can be quite dissimilar and often conflicting.

Early in the modern period, expanding use of technology allowed urban residents to experience wilderness and nature indirectly, through television, radio, newspapers, and other media. Television was especially powerful, bringing images of far-flung wilderness and the sounds of exotic species right into urban homes. Rather than experiencing wildlife damage themselves, urban residents heard about damage through the news, taking part in the stories of animals and WDM that played out in other peoples' backyards. Methods of WDM came under scrutiny by many people who watched WDM scenarios unfold via media.

In 1962, Rachel Carson's book, *Silent Spring*, increased sympathy for the preservationist paradigm, depicting the environment as fragile and interconnected. Two short years later, discontent with methods of WDM came to a head, and Congress ordered an investigation of

the federal Animal Damage Control program. Its findings, called the Leopold Report, echoed the belief that native wildlife has intrinsic value (Timm 2000, Hawthorne 2004, Miller 2007). The report also concluded that, while local population control can be part of damage management, lethal control should be limited as much as possible. However, these findings lacked public support and garnered criticism from proponents of the budding environmental movement. Three organizations sued the federal government for WDM practices that the organizations considered to be inhumane, leading to a second review of federal WDM. This second review, called the Cain Report, banned the use of toxicants for predator control (Timm 2000, Hawthorne 2004, Miller 2007).

The diversity of opinions regarding WDM in the modern period has created a challenge for managers. Thankfully, increased professionalism and organization of WDM have helped managers meet this challenge. After World War II, the G.I. Bill allowed a significant number of men to obtain college degrees in wildlife biology (Miller 2007), resulting in managers being better-educated than ever before. University classes on WDM and the development of professional organizations and societies have further contributed to the discipline's professionalism (Timm 2000). Progress continues today, as human-dimension studies expand and promise to increase our understanding of human perceptions of nature and wildlife. WDM has developed into a commercial enterprise beyond the federal government, although with an interesting paradigm twist. While tolerance of wildlife damage has increased overall during the modern period, ability to pay someone else to deal with damage sometimes surpasses tolerance levels, especially in urban areas.

Looking forward

Future challenges

What can the 4 factors of WDM teach us for the future? Human population needs will continue to grow with our growing population. While food and safety will remain primary concerns, human needs for water and health are likely to conflict with wildlife needs more in the future. Water shortages already plague

much of the western United States and will worsen if droughts continue. Already, human needs for water have gone head-to-head with wildlife water needs. As cities have expanded, many species of wildlife have adapted to live in these new environments, bringing new problems, such as zoonotic diseases. The prevalence and spread of zoonotic diseases is likely to increase with the expansion of urban wildlife populations.

In an unpredictable world, thinking about resilience can benefit both ecology and economics. As we have seen, a stable economy is an essential predecessor to sustainable WDM. Managers working in unstable or impoverished areas should keep in mind that many people view wildlife management as a luxury; until conditions are improved for the people experiencing damage, managers should realize that tolerance for nuisance wildlife will remain low (Conover 2001).

Conservation laws enacted during the industrial period have been so successful that some wildlife species became overabundant and now cause a plethora of problems. Managing these populations will require a paradigm shift, as urban residents experience damage firsthand. While many species certainly still face habitat degradation and other threats, overabundant species no longer need a “silent spring” approach, but, rather, a realistic look at how to manage these species’ populations at reasonable levels.

In addition to the paradigm shift needed to address overabundant wildlife, managers face the challenge of balancing the diverse paradigms that have arisen in the modern period. One paradigm clash is between people who lethally take wildlife (e.g., hunters and fishermen, “consumptive users”) and people who experience wildlife in a more passive way (e.g., birdwatchers and photographers, “non-consumptive users”). Consumptive and non-consumptive users frequently disagree about WDM, but both types of people who interact with natural resources are valuable in wildlife conservation efforts. People who spend time interacting with wildlife are more likely to participate in natural resources conservation, regardless of whether this interaction is consumptive or non-consumptive (Cooper et al. 2015). As in the industrial period, hunting

continues to be important for conservation. One recent study affirms that game species can be good umbrella species for conservation because efforts to restore and protect the habitats of game species also benefit nongame species present in that habitat (Crosby et al. 2015). In light of the growing disconnect between people and nature, managers would be wise to understand the various ways people interact with nature and learn how these interactions affect perceptions of WDM. Rather than splitting along the lines of consumptive and non-consumptive environmental use, all people with an interest in nature and wildlife need to recognize the importance of maintaining diverse ways to experience the natural world.

The technology that today’s WDM managers possess would astound the sword-wielding wildlife managers of old. High-tech resources, such as feral hog (*Sus scrofa*) traps with video cameras that can be controlled via cell phone, can give managers an upper hand on wildlife damage. Digital resources have made information about damage available to anyone with a computer and access to the Internet. Advancements in technology will continue to aid WDM. Technology also allows collaboration across disciplines and locations. Although much of this paper focuses on WDM in America, the 4 factors that affect WDM here also affect WDM around the world. Communication with managers around the world is beneficial to all who participate. Collaboration with disciplines similar or related to WDM, such as Integrated Pest Management, can greatly benefit our field.

Thank goodness they got all the... passenger pigeons?

Looking back through the 6 time periods of WDM, a trend emerges. Although the approaches to WDM change readily with changes in resources, economic stability, and social paradigms, a new paradigm has been growing since the industrial period: make no irreversible changes. When the frontier was closed in 1890, Americans felt the pangs of loss for wildlife and habitat that had been damaged or destroyed. Unfortunately, poor management decisions have been made since then, and we will surely make more mistakes in the future, for we humans are shortsighted by nature. But a majority of managers now recognize that while

individual animals or even local populations may cause problems, no species is intrinsically bad or harmful. Taking a broad ecosystem view, we can see that each species has its place in the workings of nature.

Overabundant wildlife, urban wildlife, and invasive species are just a few of the WDM issues that managers face in the twentyfirst century. In each of these areas, managers seek to address the problem in a way that respects the value of natural resources. Does this mean that we should not try to eradicate non-native invasive species? Of course not, but we also realize that however much damage wild boars and tamarisk (*Tamarix ramosissima*) cause in places where they do not belong, they are valuable in the places where they do belong.

It is hard to imagine what a flock of passenger pigeons was like—millions of rustling wings spread across the sky for miles. It is perhaps harder, with our full refrigerators and safe homes and office jobs, to imagine what it was like for a farmer to watch the distant sky darken as those ravenous birds advanced on his crops—his livelihood. We must remember both of these things. Wildlife damage can threaten human health and safety; empathy for those affected by damage will serve us well as we seek solutions. Among the solutions we consider though, eradication should not find any footing.

Thank goodness they got all the dragons, for we do not have to live in such terror. Thank goodness they got all the dragons, for many of us might have chosen different professions rather than deal with that sort of wildlife. Thank goodness they got all the dragons, because when we wake each day, we do not have to worry that our livelihoods or even our lives could be gone in 1 fiery breath. But, oh, if they had not got all the dragons, it surely would have been fantastic to seen one.

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