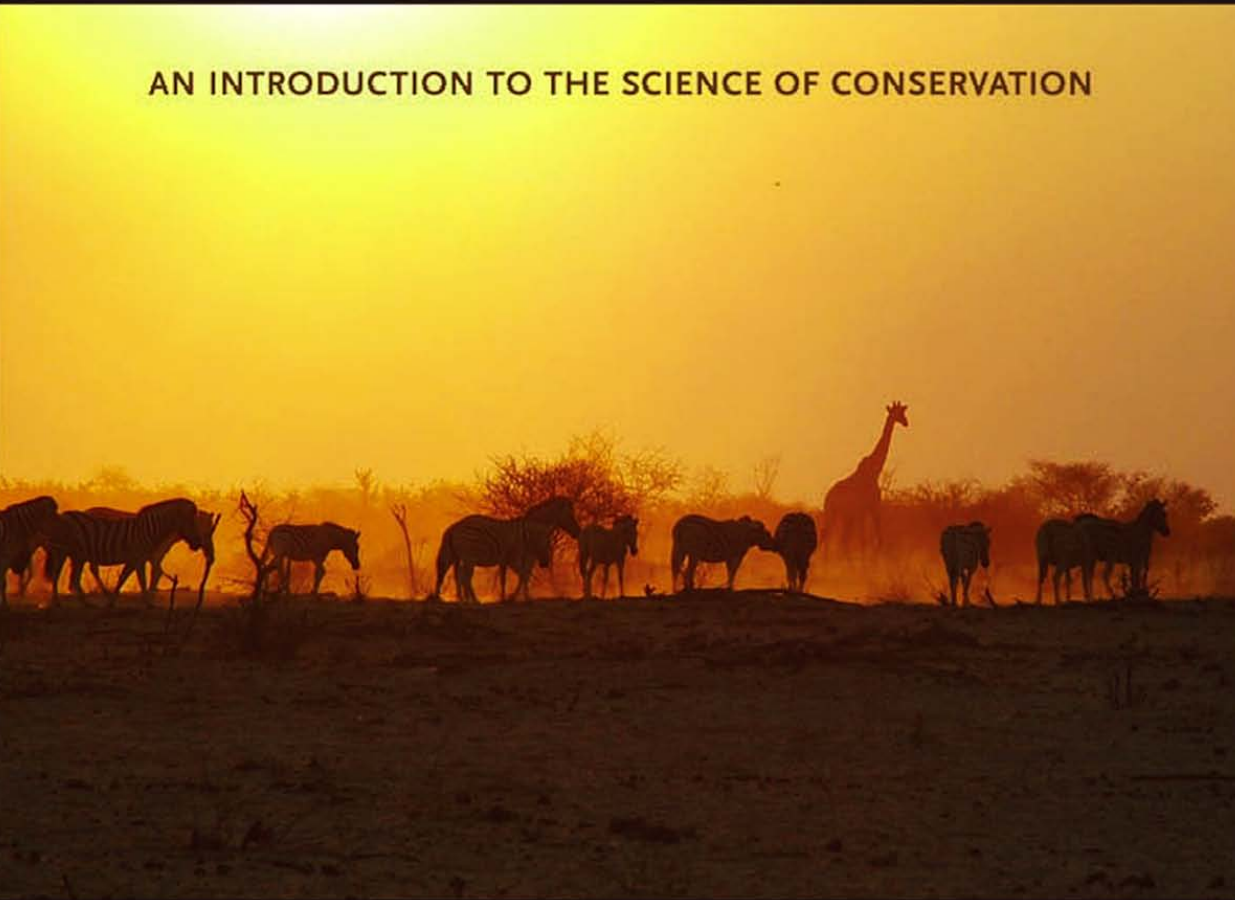


PROTECTING LIFE ON EARTH

AN INTRODUCTION TO THE SCIENCE OF CONSERVATION



Michael P. Marchetti & Peter B. Moyle

PROTECTING LIFE *on* EARTH

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Michael P. Marchetti
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If you choose not to be consciously involved in the conservation of forms of life other than your own, you should at least be aware that by doing nothing you are still having an impact on the biota of this planet. The water you drink, the food you eat, the land you live on, and the air you pollute were all obtained at the expense of other creatures. The decisions we make today on how we are going to share these resources will determine which other species will inhabit Earth for the indefinite future.

R. L. Thayer

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INTRODUCTION

The dodo was a large flightless pigeon that once inhabited the remote island of Mauritius. It was clubbed into extinction by sailors in the seventeenth century for food and sport. The dodo is remembered today mainly as a symbol of stupidity: it was too dumb to get out of the way of humans and was therefore wiped out. Unfortunately, most species sharing this “island” planet with us are “dodos.” They cannot get out of the way of human activity and will be driven to extinction unless we actively protect them and their habitats. In this book, we show why this last statement is true and also why our own future is tied to that of Earth’s diverse animals and plants. Humans and other forms of life on the planet are intertwined and interdependent, so maintaining the biodiversity of living things on this planet is, in fact, in our own best interests.

Why exactly do humans have such an incredibly large influence on other species and the natural world? We are unique among all the animals on the planet in that we survive and reproduce in a wide variety of habitats. Cultural practices have allowed us to colonize nearly every part of the Earth. As a result, the human population has continued to grow exponentially for hundreds of years. Such sustained population growth is unparalleled by any other animal

species on the Earth. For most species, their populations grow until they are fully utilizing available resources, such as food and space. At that point, natural mechanisms of regulation, such as disease and starvation, prevent the population from growing further and may cause a population collapse.

However, humans behave differently because we respond to resource scarcity with cultural tools and technologies that halt the natural regulating mechanisms and instead actually increase the availability of resources. We raise our food using intensive, large-scale agriculture, live in dense urban environments, move resources around the globe, and use medical technology to keep us alive longer. This process requires us to continually increase our resource use, and as a result, we accelerate the rate at which we alter the natural environment. Currently, the global human population is large enough and our technologies are potent enough that human-related alterations to the planet are causing unprecedented numbers of species to go extinct. If present trends continue, there will in all likelihood be a crash in the human population as we put demands on our resources beyond what the planet can sustain.

In a very real way, the root cause of the modern biodiversity and conservation crisis



lies in the fact that continued human population growth combined with increased per capita consumption is threatening most life forms on the planet. This book attempts to explain many aspects of this crisis from a biological and scientific point of view. Using accessible and straightforward language, we try to answer many questions about conservation. What are the roots of the crisis, from both a biological and historical perspective? How can understanding evolution and ecology help us to understand the crisis? What does the crisis look like, and how serious is it? Why does this crisis matter? How is society trying to address the crisis from both scientific and legal perspectives? Ultimately, how can we as individuals respond and ultimately help repair the crisis?

In this book, we provide insights into these and many other questions. Our goal is to explain to an intelligent non-scientific audience why conservation of biodiversity is a vitally pressing issue. We live in important and dangerous times, and the only way to see our way through the coming difficulties is to be armed with the power of knowledge. Yet the sheer amount of information we are bombarded with every single day sometimes has the effect of crushing our desire and ability to learn and grow. Much of the human population feels that it is easier to ignore or put aside those things we don't understand. Compounding this problem is the fact that scientists (like us) have a tendency to speak like scientists; they love to convey information using esoteric jargon and revel in the scientific

complexity and uncertainty. Unfortunately, as a result, many people tune out when they hear yet another scientific expert pontificate. We want this book to help bridge the gap between the science of conservation and the people who can and will make the difference: namely, the general public and the people they select to make policy.

In other words, we want to reach out to *you*, the individual who makes hundreds of small but critically important decisions that affect wildlife, biodiversity, and global ecosystems every single day. We want *you* to understand on a straightforward, heartfelt level why conservation is a vitally important topic and how conservation issues touch so many aspects of our daily lives. We want you to come away with reliable information to help inform the challenging environmental decisions we make every day. These are decisions on topics that range from voting on environmentally related issues, to deciding how we as individuals and as a nation spend our money, to determining how we get to work in the morning, to choosing what to put into our mouths when we eat. This book was written to help explain how the science of conservation is at the heart of helping you make informed decisions. You will notice that it has a distinct bias toward using wild vertebrates ("wildlife") as examples. This reflects both the interests of the authors and the fact that we humans have a greater empathy with the creatures that are the most like us.

In addition to targeting a wide audience, we designed this book to be used as a text in a college classroom. It is divided into convenient chapters, each of which addresses a major subject within conservation to make it convenient for instructors to pick and choose topics they wish to cover. The chapters, however, are placed in a logical sequence for learning. We start with a brief introduction to environmental history, followed by introductions to the sciences of evolution and ecology. We then provide a series of chapters on major issues related to conservation of biodiversity, ending with some suggestions as to what you can do to help out the planet.

BOOK ORIGINS

The ideas and examples we use in this text have been field tested over decades of experience in the classroom by both authors. The origins of this book lie in a graduate student exercise in the 1980s by one of the authors (PBM). He gave the students the charge of each writing a chapter for a reader that would explain issues in conservation to a non-science audience. Many drafts later, a version of this early “reader” was used by hundreds of students at the University of California, Davis, for over a decade. This reader was continuously revised over the years by one of the authors (PBM), with the help of others who co-taught courses with him, in particular Douglas Kelt. The book thus rests firmly on the shoulders of many fine students (now practicing conservation scientists), who contributed directly to the various versions, including Anne Brasher, Jay Davis, Steve Ellsworth, Robert Meese, Mary Orland, Anitra Pawley, and many others. We thank them for their skill and clarity of thought that laid the foundations for this new book.

The authors acknowledge the following individuals, all of whom contributed in some way and without whom this book would never have

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Environmental History

Human interactions with the environment are constantly changing. This is well illustrated by the history of human-wildlife interactions in North America, a continent that has been inhabited by us humans for “only” the past 13,500 years. Our history here is also a brief history of the concepts of *nature*, *wilderness*, and *wildlife*. A discussion of the changes in meaning of these seemingly simple terms highlights the dramatic changes that have occurred in our understanding of the world we live in. The history of these ideas reflects our changing attitudes toward the environment in a broader sense and helps to illuminate how we have gotten ourselves into the present environmental crisis. An understanding of environmental history also provides reasons to think that there is at least some hope we can work our way out of the present crisis with many of our natural systems intact. In order to better delineate such a long period of history, we break the historical record up into somewhat arbitrary “eras” that are borrowed from *An Introduction to Wildlife Management* by J. H. Shaw (1985). The exact dates for these eras have little meaning by themselves but

instead act as indicators of cultural shifts that are largely continuous in nature. This chapter serves as an introduction to the entire book. We introduce ideas, terms and topics that we will revisit many times in the coming chapters. Our goal is to provide a basic understanding of the historic roots of modern conservation biology and of the global environmental crisis.

PRE-EUROPEAN ERA (11,500 BC TO AD 1500)

Humans invaded North America some time during the last ice age, roughly 13,500 years ago, when sea levels were lower and it was presumably possible to walk across the Bering Land Bridge connecting Asia and Alaska. Although evidence is scanty, it appears that once the glaciers melted sufficiently to allow passage out of Alaska, colonizing bands of human beings spread across the continent. Using boats, they apparently moved along the coast, down to the tip of South America, in less than 1,000 years. Even at this early stage of the human invasion, there is evidence to suggest that people had a

major impact on their environment and the wildlife with which they lived.

Before humans entered the picture, North America had an impressive assortment of very large mammals and birds. Many members of this group were plant eaters (herbivores) and included elephants (woolly mammoths, giant mammoths, and mastodons), horses, camels, giant bison, giant ground sloths, giant armadillos, tapirs, giant beavers, giant tortoises (roughly the size of a small car), and a giant pig that was as large as the largest boars of Europe. An entire group of now extinct megapredators preyed on these large herbivores, including cheetahs, saber-toothed tigers, giant wolves, and two species of lion (one larger than the modern lions of Africa). There also existed a truly fearsome short-nosed bear, about twice the size of a modern grizzly bear, which ran down its prey as cheetahs and wolves do today. Jaguars lived far north of their current tropical latitudes, into the forests of Canada, as did many of the New World cats now restricted to Central and South America. There also existed a group of large meat-eating birds, the largest of which were the teratorns, scavenging birds with wingspans up to 5 meters. The endangered California condor is the last remnant of these giant scavenger birds. There was even a giant vampire bat adapted to feeding off the blood of these enormous beasts. So, why isn't North America still home to this wonderful array of creatures?

PLEISTOCENE OVERKILL

The fate of the giants of the past has been the topic of much debate, but considerable evidence supports a hypothesis called "Pleistocene overkill." The idea is that, as humans spread across North and South America, they preyed upon the large herbivores, such as mammoths, ground sloths, and tortoises, and wiped them out. As originally formulated by Paul Martin, the idea was that the large mammals were driven to extinction in a few hundred years in a blitzkrieg-like event. A newer version of the hypothesis is

that the extinctions were more gradual, based on evidence that, in some areas, humans and large animals coexisted for long periods of time, despite hunting. However, the end result was the same: extinction of the megafauna. Large animals are more vulnerable to extinction than smaller ones because they cannot hide easily from human predators and because they reproduce quite slowly. It is possible that the large animals were also relatively unafraid of human beings, because they would have evolved for hundreds of thousands of years without humans present. In addition, there is some indication that a rapid shift in climate reduced the habitats of many of the giant herbivores, making them more vulnerable to human predation. Likewise, Australian biologist Tim Flannery suggests humans may have changed the environment through their actions, especially by increasing the frequency of fires.

Not unexpectedly, when the large herbivores disappeared, their natural predators, such as saber-toothed tigers and short-nosed bears, became extinct as well. The large scavenger birds, which had adapted to eating the remains of large animals, also followed them into extinction. The California condor may have held on because it had access to the carcasses of large marine mammals such as whales and sea lions, which did not go extinct at this time. The loss of these giant animals also impacted the diversity of smaller animals. Because abundant large animals (such as mammoths and tapirs) alter plant communities by the way they graze, their disappearance would have caused a shift in the plant communities, resulting in the extinction of many smaller species that depended on the habitats maintained by the large grazers. In fact, there existed a grassland ecosystem in Alaska called the *mammoth steppe* that disappeared entirely once the woolly mammoth went extinct in that region.

The idea of the Pleistocene overkill is quite controversial, yet the principal alternative to explain the rapid loss of all these giant animals is a drastic climate change that occurred with the end of the ice age. Recent fossil data

and archeological discoveries increasingly support the idea that the first native peoples were responsible for the extinction of many species.

One of the early groups (but not the first) to colonize North America was the Clovis people. At Clovis archeological sites, researchers have found distinctive, beautifully made stone spearheads that would have been well suited for killing large herbivores. These same Clovis spearheads have been found imbedded in the skeletons of large animals, which strongly suggests that these animals were hunted by the Clovis people. Clovis culture rapidly spread throughout North America, and then rather abruptly disappeared after about 300 years—a disappearance that seems to coincide with the extinction of many (but not all) of the large animals of interior North America.

Additional support for the overkill idea comes from data from the growth rings of mammoth tusks at the time of the mammoths' extinction, which indicate that the animals were eating well and not experiencing the starvation that would normally accompany climate-driven extinction. Also, many of the extinct species of megafauna had already survived several other glacial climate cycles during the previous 100,000 years, and so presumably they could have survived one more. It is worth noting that a similar event occurred in Australia, with early humans apparently wiping out a suite of giant marsupials, as well on islands throughout the world. If we accept some version of the Pleistocene overkill hypothesis, then we also have to accept the idea that early hunter-gatherer societies were capable of having large and permanent effects on their environment.

DISEASE AND WILDLIFE POPULATIONS

When the first Europeans arrived in North America they were often impressed with the abundance of wildlife. For example, when Daniel Boone brought colonists to settle the Ohio Valley, he led them into a wilderness of large trees, teeming with deer and bear. Two

hundred years earlier, however, this same valley had been largely cleared for farms, which were tended by a dense population of native people. The main cause of the disappearance of so many of the First People at the time of European contact was disease.

Disease epidemics are most likely to occur in dense populations of animals or humans because pathogens can spread more easily among individuals and there is a large supply of susceptible hosts for the disease. Not surprisingly, high population densities in urban centers of Europe and Asia supported many nasty communicable diseases, such as smallpox, measles, chicken pox, bubonic plague, malaria, cholera, yellow fever, and influenza. Most Europeans were relatively immune to diseases such as measles and smallpox because they had essentially evolved with the diseases, many of which originated in pigs and other livestock. The plagues such as Black Death that periodically swept through Eurasia, killing millions of people, were powerful agents of natural selection (see Chapter 2). When Europeans came to America, they brought these diseases with them; unfortunately, the native peoples had virtually no resistance to the diseases. Smallpox, measles, and other diseases carried by the early explorers, from Columbus onward, rapidly swept through the continent, dramatically reducing Native American populations. Cortez's conquest of Mexico, for example, was greatly hastened by the reduction of the Aztec population by a measles epidemic.

To say that the effect of these illnesses on the population of the Americas was devastating would be an understatement. It has been estimated that, by the end of the seventeenth century, between 70 and 90 percent of First People had died from European-imported diseases. When the native peoples were wiped out, their game species responded by increasing in number. If you remove major predator, such as humans, then prey numbers will increase, at least temporarily. Thus, the first impact of Europeans on wildlife in the Americas was probably to increase wildlife populations through the

tremendous and tragic reduction of the populations of indigenous peoples.

BELIEFS AND ATTITUDES TOWARD NATURE AND WILDLIFE

Many of the earliest North American peoples were hunter-gatherers, meaning that they collected most of their food and were often migratory or nomadic in their behavior. Other groups were more sedentary but managed the local landscapes to produce the goods and services they needed, using tools ranging from fire (to favor desirable grasses and shrubs), to irrigation of crops, to regulating the catch of salmon coming up rivers. No matter where the native peoples were on the spectrum of environmental manipulation, they were dependent on understanding the natural world for their survival. This direct dependence on natural ecosystems required an intimate knowledge of the natural world that was often reflected in their beliefs and attitudes toward nature and wildlife. Such peoples commonly viewed themselves as inseparable from the natural ecosystems and wildlife around them. Animals were often regarded as another “kind” of people, or as spirit beings, who could be appealed to for help and protection. Rituals were commonly performed to show respect, gratitude, and reverence for the animal spirits, with the hope of promoting continued harvest success. Other rituals served to influence natural events, such as the coming of rain, or the harvesting of a crop such as acorns, maize, or wild grains.

The belief in magic, ritual, and the intimate fusion of humans with the natural world can be seen in the cultural traditions of many native cultures, as well as in the wonderful portraits of bison, deer, bighorn sheep, salmon, and other animals painted on cliff walls or in caves. As a species, we *Homo sapiens* have been hunter-gatherers for most of our evolutionary history; in this time, we did not separate nature, wilderness, and wild animals from human culture. Some anthropologists suggest that, as a result of this connection to nature and wilderness, we

experience deep-rooted psychological feelings of well-being when we are placed in circumstances that mimic our ancestral environments. Such environments include natural settings (such as forests and prairies) with views of wildlife (or domestic animals), often near water, especially when frequent interactions with close family members are involved.

ERA OF ABUNDANCE (1500–1849)

Early European descriptions of the New World emphasized the incredible abundance of plant and animal life. The Europeans were astounded by the sheer number and variety of fish available. They were left speechless by the flights of passenger pigeons and measured their numbers in the “millions and millions.” Accustomed to firewood shortages in England, settlers were delighted by the variety and abundance of trees in the forests. Unfortunately, in the settlers’ minds, the new landscape also contained native peoples, even if their populations were in low numbers because of disease epidemics.

When European settlers came into contact with the indigenous peoples of North America, four factors, all of them related to perceptions of animals and nature, allowed them to justify taking from the natives. First, the unsettled areas of the continent were regarded as inhospitable wild areas that were feared and that needed to be tamed to allow them to be used. Thus, conversion of wilderness to farmland and cities was regarded as a good thing.

Second, settlers generally thought that the native people who lived on the land were not using the land properly. They did not “own” the land in the European sense. Because the native urban cultures had largely disappeared, the native peoples the Europeans encountered were largely hunter-gatherers or practitioners of shifting agriculture, meaning that they would clear a field and then move on when the field began to lose its fertility. European farmers, on the other hand, were accustomed to a system in which a person would farm the same piece of land “in perpetuity,” regardless of the health

or fertility of the soil. Europeans viewed Native Americans, as “lazy,” because they engaged “only” in hunting and fishing. Such activities, in Europe, were leisure activities, not integral parts of a cycle of the seasons as they were for most of the First People. It was much easier to justify taking land from people who were lazy, who didn’t own the land, and who were not living up to the biblical commandment to subdue the Earth.

Third, the devastation of native peoples by European diseases (when it was recognized at all) was regarded as an act of Providence, favoring the obviously superior European culture. In the wake of depopulation and social chaos, taking “unoccupied” land seemed not only justifiable but prudent.

Finally, Europeans perceived the environment of the New World not as a set of integrated ecosystems but as a collection of commodities. These commodities, in incredible abundance, were apparently free for the taking. In addition, they saw not only the land but the animals and plants that lived on it as private property. Whereas in most hunting and gathering societies an animal belongs to the individual who kills it, in European society, wildlife was owned by the people who owned the land. When Native Americans “sold” land to Europeans, they perceived themselves as merely sharing the use of the land. Europeans perceived themselves as buying the land and everything on it, regardless of the way the land might be used. These ideological and economic differences caused conflict repeatedly and still do to a certain extent. This can be seen in the history of beaver trapping.

THE BEAVER TRADE

The beaver trade was stimulated by the need of the early European colonies to find a commodity that would repay the debts they owed to European merchants. European settlers and traders were quite aware that they were not as efficient as native hunters, so they hired native people to do the hunting for them. As “lazy” as native peoples were perceived to be, Europeans admitted that they were superb hunters and trappers.

Traditionally, hunting peoples had traded with agricultural peoples on the southern coast of New England, exchanging maize (corn) for pelts. Europeans inserted themselves into the traditional network, initially using *wampum* (shell beads) as currency. However, the context was very different: traditional Native American trade had been based on a complex network of kinship and friendship and had primarily been local, from village to village (although some peoples also made long trips for trading purposes, to acquire precious goods such as obsidian or copper). The new trans-Atlantic fur trade stretched over long distances. However, as a result of native populations being dramatically reduced by disease, traditional kinship groups had largely broken down, and the original networks of trade were weakened.

The idea of beaver pelts as a commodity, as something that could be removed from the environment with no consequences, had massive ecological and social repercussions in New England and throughout the beaver range. Earlier, Native Americans had had little incentive to kill more animals than they needed. They never accumulated animal skins beyond the need for personal use and a little barter. In many tribes, all of a person’s possessions had to be moved many times a year as the village or family followed animals seasonally. Because the native people lacked large draft animals, except dogs, everything a family owned had to be carried on family members’ backs. Pre-European trade thus was inherently conservation oriented. When the traditional trade practices were altered by European colonists, the disintegration of earlier, more ecologically friendly practices followed.

In New England, it was clear by 1640 that beaver numbers had declined. By 1650 the trade in Massachusetts was described by its founder, William Pyncheon, as “of little worth.” Nevertheless, from 1652 to 1658, Pyncheon’s son managed to procure 9,000 beaver pelts as well as hundreds of moose, otter, muskrat, fox, raccoon, mink, marten, and lynx skins. By the end of the seventeenth century, the beaver trade was dead in New England, yet the fur trade continued

through the eighteenth century. When one area became trapped out, hunters and trappers would move farther inland, especially into the difficult terrain of interior Canada. By the end of the eighteenth century, the fur trade became no longer profitable, in large part because beavers and other fur-bearing animals had become extremely scarce across North America.

The conservation implications of the beaver trade went far beyond the extinction or decrease in the range of the species. As beavers disappeared, eventually the ponds held behind beaver dams became full of silt, and the dams collapsed. The rich soil that was exposed was prized by settlers for its agricultural and pasture potential. The destruction of beaver populations, in much the same way as the epidemics, actually opened up land for European settlers. Westward moving beaver trappers were followed by farmers, who sought out the good meadowlands around streams that had once supported beavers.

Another consequence of the near extinction of the beaver was major changes in the plant and animal communities in and along streams. Beavers cut down trees, reducing shade and increasing the diversity of smaller plants, which in turn provides food for rodents and other herbivores. Naturally abandoned beaver ponds become meadows, which support elk, deer, bear, and other large animals. The beavers' actions increase the complexity of both the terrestrial and aquatic environments around them. Thus, the disappearance of the beaver from an area may result in the decline of other large animals, as well as their predators. In the western United States, for example, it is likely that declines of coho salmon and other migratory fish were hastened by the shortage of rearing habitat for juveniles that had once been provided by beaver ponds.

By the time the beaver trade collapsed, many native communities had changed beyond recognition. Instead of producing most of the goods necessary for survival, the people hunted and trapped fur-bearing animals and sold all of the pelts they acquired. They became dependent upon European trade goods such as blankets,

fabrics, and food. By the 1660s, with the beaver gone, the native peoples of New England turned to the one commodity they had left to sell, their land. Those few who had survived epidemics, loss of income and trade, and loss of land began to keep European livestock. In the far north where the beaver trade continued, native peoples began to accept European notions of animals as property. Territories used by particular bands became more fixed in an attempt to conserve and ration the beavers that were left.

It is ironic that today the combination of decline in the value of beaver pelts and the protection of beavers has resulted in an explosion in beaver populations, including some in urban areas. Beavers are often regarded as pests because they block drain culverts with dams, which results in the flooding of roads and parks, because they burrow into levees and weaken them for flood control, and because they cut down trees planted for home landscaping or stream restoration projects.

The decline (and resurgence) of beaver populations demonstrates the unanticipated consequences of intense exploitation of a key species to the natural landscape for a host of other species, including humans. Their loss is symbolic of the profound changes that took place in North America as the landscape switched from being dominated by indigenous peoples to being dominated by Europeans. It was also an early example of changes that became commonplace during the "Era of Overexploitation."

ERA OF OVEREXPLOITATION (1850–1899)

This era was one in which the North American continent was transformed from a land of apparently limitless wilderness and natural abundance to one with cities and farms scattered everywhere, held together by a spidery network of railroads, roads, and telegraph wires. This time period saw rapid settlement of the West Coast (catalyzed by the discovery of gold in California); the Civil War; the virtual disappearance of eastern forests; an enormous influx of immigrants from Europe, Asia, and Africa;



FIGURE 1.1. These three woodcuts reflect a nineteenth century view of nature as something that needed to be controlled or tamed, exaggerating its fearful aspects with imagery such as an eagle carrying off a small girl (no eagle is large enough to do that!). (These are a few of many similar illustrations from a popular book on natural history by Buel, J. W. 1889. *The living world: a complete natural history of the world's creatures*. Holloway Publishing, St Louis, MO.)

and a vast expansion of industry and technology. The large increase in human population during this era, combined with the technology of early industry and the demands of a market economy, caused wildlife populations to plummet from a combination of overexploitation and environmental alteration. Some of the many examples include the following:

- The vast migratory herds of bison on the Great Plains were systematically

slaughtered or died of cattle-borne diseases until only a few hundred individuals were left.

- The passenger pigeon, whose numbers were once reckoned in the billions, became extinct in the wild. Both adults and young were harvested commercially. The last bird died in captivity in 1914.
- Heron and egret populations were razed by hunters shooting them in their breeding colonies for plumes for ladies hats.

- The ranges of large predators such as grizzly bears, mountain lions, and wolves became greatly reduced. Mountain lions and wolves were virtually eliminated from eastern North America, as were grizzly bears from California (found on the state flag no less) and most of the rest of the western United States.
- White-tailed deer became extremely scarce in the eastern United States through a combination of habitat loss and overhunting.
- Runs of salmon and shad disappeared from most eastern rivers; their runs were blocked by mill dams, or they were killed by factory wastes in combination with unlimited fishing.

The drastic decline of wildlife is not really surprising, considering the attitudes of most people living in this era. Nature was regarded as something that got in the way of civilization and progress, and as a source of goods to sell on the market. People were often frightened by the abundant wild animals and uncontrolled wild ecosystems and thought nature and wilderness had to be tamed and controlled. Thus, popular nature books of the era were filled with drawings of animals doing nasty things to people or to each other: bears clawing hunters, eagles carrying off children, deer goring one another, land crabs attacking goats (Figure 1.1). One of the worst examples of overexploitation during this time is illustrated by the story of the American bison.

BISON AND POLITICS

Bison, often referred to (incorrectly) as buffalo, are one of the most enduring symbols of American wildlife and the “Wild West.” Enormous herds of bison on the Great Plains could number in the millions, and it has been estimated that the total bison population in North America at one time reached over 30 million individuals.

By the end of the seventeenth century, the new United States had ceased to be centered

in the colonies of the Atlantic Coast, and the westward expansion of European settlers had begun. Settlers often held a belief that they were divinely appointed users of the American earth and that this use was for the good of all humankind. Politicians of the eighteenth and nineteenth centuries argued that the native peoples needed to give up their territory because they had no use for it except hunting, gathering, and fishing and they should adopt the “superior” European cultural ways. Even agricultural peoples who held land in common, such as the Cherokees of the southeast, were not considered to be proper farmers. In fact, native people were often compared to animals; they were believed to be genetically inferior to Europeans; their cultures were believed to be “savage.” The word “wild” was often used to refer to native people, especially to those who refused to give up their way of life to partake of that of Europeans. This came to be the dominant language among both American political thinkers and people who were taking part in the westward expansion. As a result, any action was justified, as long as it had the effect of removing “savages” from land that obviously would be better used by Europeans. This included removing natural food supplies. The most blatant example of this process was the destruction of the bison herds by white hunters.

The descriptions of bison by early European explorers are reminiscent of the words of settlers who first came to New England and described the native wildlife. Millions of the creatures inhabited the area between the Mississippi River and the Rocky Mountains. George Catlin, the famous nineteenth century American painter, commented in his journals that the herds he saw stretched as far as the horizon.

The native peoples of the Great Plains began hunting bison intensively in the early eighteenth century, almost as soon as they had acquired horses. A number of tribes gave up their earlier, more settled existence to follow the herds. By the time of European settlement 100 years later, their culture was almost entirely dependent upon the bison. Though older

religious and social institutions still existed, it is clear from the customs, songs, and kinship networks that bison were the center of these tribes' lives. Everything from tents and shoes to glue was either derived from the bison or from smaller animals that were hunted in addition to it. Virtually every part of the animal was used, unless large numbers were killed at once.

In the early history of European settlement, the East Coast colonists had no real interest in settling in the Great Plains. Explorers such as Lewis and Clark and those few settlers who crossed the Plains on their way to Oregon, California, or the Southwest generally described the Plains as a "howling wilderness," best traversed as quickly as possible. In the 1830s and 1840s, few Americans believed that the native people who lived on the plains were much of a problem. The critical events that changed this attitude were the discovery of gold in California in 1849 (and subsequent discovery of silver in Nevada and gold in Colorado) and the completion of the transcontinental railroad 20 years later. In order to exploit the new mineral commodities, it was necessary to get through the Plains and past the Native American "savages," who roamed across the area.

In the late 1800s, the U.S. government used three tactics to clear the First People out of the way: (1) military attacks, which were only intermittently successful, (2) deliberate spread of epidemic disease to isolated groups of peoples (through infected clothes and blankets), and (3) destruction of the bison herds. Particularly in the two decades following the Civil War, hunters literally killed bison by the millions. Sometimes carcasses were left to rot; sometimes the animals' tongues and hides were taken. Two to four million were killed each year during the 1870s. Twenty thousand hides were sold in St. Louis in one day. Even the animals in Yellowstone did not escape the slaughter. During the 1870s and early 1880s, bison were killed there by the thousands. Like other game animals, bison were killed and eaten by park employees. In 1882, to save money on beef, one of the first concessionaires in Yellowstone hired professional hunters

to provide 20,000 pounds of elk, deer, mountain sheep, and bison meat. Only the intervention of the U.S. Cavalry in 1886 and its effort to stamp out poaching in the park saved the last 25 bison and other large herbivores from being exterminated from our first national park.

By the early 1880s, native peoples could no longer find bison in the numbers required to sustain themselves. Like the people of the East Coast, with their livelihood gone, they became increasingly dependent upon imported American and European goods and foods. A few escaped to Canada, where they continued to follow the diminishing bison herds, but, in desperation, many agreed to sign treaties ceding the majority of their land to the invaders in return for food and clothing. By 1889, 85 wild bison were left outside Yellowstone National Park, and the last of these was shot in Colorado in 1897. By 1902 there were only 20 individual bison left in Yellowstone, and 150 in Canada. The species had gone from over 30 million to less than 200 in a few decades under the onslaught of early western industrial society.

Today, there is growing recognition of the devastating impact the loss of bison had not only on the native peoples but on the Great Plains ecosystem in general. As the bison herds slowly rebuild on both public and private lands, so does the appreciation of their adaptation to the prairie environment and of the potential to recreate large open areas of grazing land from which bison can be harvested in a sustainable fashion. The creation of a "buffalo commons" has the potential to provide enormous benefits to the land, the prairie ecosystem, and the people who live there.

ROOTS OF THE CONSERVATION MOVEMENT

Despite this dismal picture, the Era of Overexploitation also contained roots of the modern conservation movement. Over the clamor of self-congratulation for having subdued the remote, barren, rocky, bushy, wild-woody wilderness into a second England, a few individuals asked

if this transformed environment was what people really wanted. Henry David Thoreau in 1855 sat down with his journal beside Walden Pond, the local swimming hole in his hometown of Concord, Massachusetts, to consider the ways in which Concord had been altered by two centuries of European settlement and expansion. Taking a 1633 account of the area and comparing it to what he saw around him, he concluded that the changes had been drastic. In *Walden* he listed animals and trees that were no longer present in Concord in 1855, and then wrote:

I take infinite pains to know all the phenomena of spring, for instance thinking that I have here the entire poem, and then, to my chagrin, I hear that it is but an imperfect copy that I possess and have read, that my ancestors have torn out many of the first leaves and grandest passages, and mutilated it in many places. I should not like to think that some demigod had come before me and picked out some of the best stars. I wish to know an entire heaven and an entire earth.

Thoreau was not the first to comment on the changes in the environment he saw around him. Unfortunately, however, until the twentieth century, writers like Thoreau could find almost no audience. Most Americans at the time believed strongly in the idea of Manifest Destiny, whereby the United States was seen as having a divine imperative to conquer and subdue the lands from coast to coast and therefore had little interest in writers like Thoreau. People homesteading on the plains, if they read Thoreau at all, would have thought of him as one of the educated elite who knew nothing of their struggles to turn wilderness into productive farmland. It was only later that Thoreau's genius was recognized and his philosophical stance held in high regard.

Also during this era, Charles Darwin published *On the Origin of Species* in 1859, which further fueled the arguments that humans were part of nature, not separate from it, and that humans had a great impact on the natural world, including causing the extinction of species. Such ideas were not quickly absorbed

by mainstream America, but people in this era were slowly becoming aware that the country was losing its natural heritage. Thus, during this time, the first game wardens were hired, some states began requiring hunting licenses, fish and game commissions were established to find ways to improve hunting and fishing, and Yellowstone National Park was established.

Yet even these efforts were based on a philosophy that humans could improve upon nature and that wilderness and wild things needed to be under human control. Thus, the newly established fish and game commissions often took their major task to be the introduction of new species. The largest railroad cars that existed in this era were those designed to carry fish back and forth across the continent so they could be stocked in places that needed improvement. Striped bass and American shad were introduced to California from the East, with the cars bringing back rainbow trout and Pacific salmon for introduction into eastern streams. Carp from Europe were introduced everywhere and were considered to be so much better than native fishes that, for a while, pools beneath the Washington Monument in Washington D.C. were used to rear them.

ERA OF PROTECTION (1900–1929)

At the turn of the twentieth century, most Americans were still rather oblivious to the environmental deterioration that was occurring everywhere, but some of them were outraged by the uncontrolled hunting that was eliminating populations of the most spectacular animals, from deer to herons. The focus of this era was to gain some minimal level of protection for desirable animals, in part so they could continue to be harvested.

The era began with two significant events: the passage of the Lacey Act in 1900 and the accession of Theodore Roosevelt to the presidency of the United States in 1901 (Figure 1.2). The Lacey Act helped to eliminate market hunting for plumes from birds (by prohibiting interstate commerce in feathers) and was passed



FIGURE 1.2. Teddy Roosevelt and John Muir at Glacier Point, above Yosemite Valley, California, in 1903. As president, Roosevelt protected vast stretches of the American wilderness, including parts of what would become Yosemite National Park. John Muir's writings and activism helped form the Sierra Club and protect Yosemite Valley and Sequoia National Park. (Library of Congress Photo.)

in part due to lobbying from newly formed Audubon Societies. The period of the Theodore Roosevelt presidency is considered by many to be a golden age of conservation. Roosevelt, an ardent hunter and conservationist, tripled the size of forest reserves to 148 million acres and created the U.S. Forest Service to manage and protect them. He pushed Congress into passing legislation that withdrew 80 million acres of public land from exploitation for coal and 4 million acres from exploitation for oil. He created the first national wildlife refuge (which snowballed into the National Wildlife Refuge System), created many national parks and monuments, and beefed up federal enforcement of wildlife laws. Roosevelt also used the 1906 Lacey Act to set aside several million acres of public land as national monuments. In 1913 and 1916, laws were passed that essentially made

hunting of most migratory birds, except waterfowl, illegal.

The conservation movement in the United States continued to grow in the early part of the twentieth century. Some individuals such as John Muir (Figure 1.2) realized that mere preservation of wilderness areas was not enough. He helped found the Sierra Club in 1892 in an attempt to get ordinary people involved in and educated about wilderness. Why, Muir asked in his writings, was there such a dichotomy between lifeless cities and untrammelled wilderness? Could city people care about wilderness they might never see? Muir thought they could. The Sierra Club advocated the establishment of Yosemite National Park in John Muir's beloved California Sierra Nevada mountains—what he called the “Range of Light.” The Sierra Club attempted to preserve not only the Yosemite

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