

1

Historical Context

Beginnings of Formal Utilitarian Conservation

In this chapter, we will look at the historical roots of formal conservation. We will see how the disciplines of wildlife management, forestry, range management, and soil science arose in response to threats to living natural resources that followed intensive exploitation, habitat alteration, and the introduction of non-native species. These disciplines are primarily utilitarian in their approach. They focus on the exploitation of economically valuable species to protect a long-term supply. To exploit something (a natural resource or a person's labor) is to use it, but the term often carries an implication of excessive use, unfair use, or use without appropriate compensation. In this book, the term *exploitation* as applied to the use of resources is meant to be synonymous with utilization, without a connotation of exorbitant or inappropriate use, although we will see many examples of unregulated or excessive exploitation that resulted in depleted wild plants and animals.

1.1 Royal Reserves and Sacred Groves

Many rulers of ancient and medieval societies issued decrees regulating the use of wild plants and animals. Such rules are sometimes held up as the “earliest traces of a conservation conscience” (Alison, 1981), but that designation assumes that societies which lacked authoritarian rulers were incapable of conservation. It ignores customary or informal arrangements regulating who, what, when, where, and how wild plants and animals could be used. Rulers were not the sole, or arguably even the most important, source of early conservation. In early human societies, community norms ordered people's relationships with the natural world. These norms included the delineation of revered places and customary taboos dictating what uses were allowed within those places (Box 1.1). A patch of forest, mountain, river, spring, cave, or other features of the environment might receive such a designation. Piecing together a picture of these ancient places of spiritual significance requires a multidisciplinary approach including information from sacred texts, historical records, archaeological artifacts, natural records such as pollen cores, and the oral traditions and traditional ecological knowledge of Indigenous people, which often describe practices understood to date from time immemorial.

Kings, emperors, sultans, and czars decreed limitations on peasant uses. These regulations were aimed at reserving certain resources for rulers, aristocrats, and the clergy. During the Middle Ages, monarchs in many parts of the world, including Britain, France, Japan, Africa, and Java, reserved some forms of resource use, such as hunting, for the elite (Olson, 1984; Grove, 1990). For example, after the Norman invasion of Britain, common grazing lands were enclosed, and the conquerors marked off large areas of land for the “pastime or ‘game’” of hunting by the king and some members of the gentry (Cox, 1905:5). Privatization of land for enclosure was encouraged under feudalism. Local people had rights to some kinds of resource use, however, such as collecting firewood and medicinal plants, harvesting grass, pasturing animals, and sometimes cutting timber (Peluso, 1992; Williams, 2003).

By the sixteenth century, England witnessed the rise of a country gentry that regarded owning land as a capital investment. To obtain a return on that investment, it was deemed necessary to improve the land. Marshes were drained to create farmland, and common lands were enclosed. Land improved in these ways could be defined by abstract boundaries. This trend led to a growing privatization and commercialization of the landscape (Ingrouille, 1995). *Bogs*, freshwater wetlands consisting mainly of partially decayed vegetation known as *peat*, were regarded as the product of laziness (“want of industry”) in “barbarous” countries such as Ireland and Italy. William King, an Anglican clergyman in Dublin, wrote in 1685 that “An act of Parliament should be made ... that who did not in such a time, make some progress in draining their *Bogs*, should part with them to others that would” (King, 1685:955). Similar changes in much of the rest of Western Europe followed.

Box 1.1

Examples of Sacred Groves in Madagascar and India

Two examples of natural features that have been revered and protected for centuries or millennia are described below.

Sacred groves in spiny forests of southern Madagascar: In interviews with researchers, Indigenous people of the Androy region of southern Madagascar (Figure 1.1) have described practices relating to the protection of sacred forests dating to the time of their ancestors. For centuries and perhaps millennia, people of this hot, dry region of spiny thickets (a type of vegetation characterized by plants adapted to low and variable rainfall) have recognized several kinds of sacred places. Harvesting honey, a food with medicinal and ceremonial uses, was regulated within honey groves by means of taboos. Stricter taboos regulated access to and use of ancestral spirit sites associated with pre-burial ceremonies, burials, and funerals (von Heland and Folke, 2014).

Sacred grove of the goddess Janni in the Western Ghats of India: Today many sacred groves are found in the Western Ghats, a chain of hills along the western edge of the Indian peninsula (Figure 1.1). One of these is dedicated to the goddess Janni. Worship of Janni in this grove may have begun as worship of an early fertility goddess, perhaps dating to a nomadic hunter-gatherer culture before village settlement. Although about 5 m of rain falls on the grove during the monsoon season from June through September, rain is sparse during the rest of the year. Trees and woody vines dominate the vegetation, but the understory is sparse. In the past, taboos prevented almost all extraction of vegetation from the grove (Gadgil and Vartak, 1975).

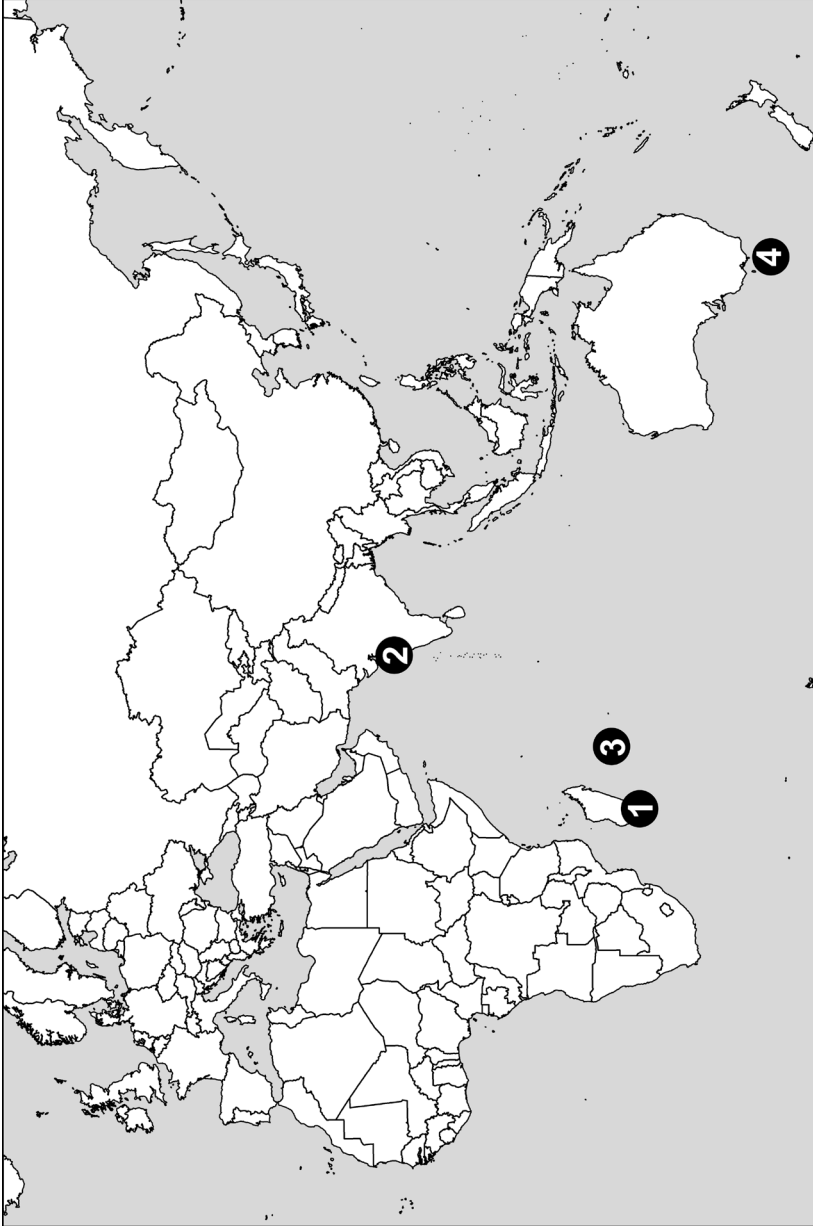


Figure 1.1 Locations of: 1, sacred groves in Androy region, Madagascar; 2, sacred grove of the goddess Janni, Western Ghats mountains, India; 3, extinct giant tortoises, Mauritius; 4, extinct Tasmanian wolf, Tasmania. Map created by Eva Strand using Esri, DeLorme World Countries Generalized Data & Maps for ArcGIS 2013, with permission.

When Europeans arrived in the lands that later became the USA and Canada, these ideas influenced the ways in which they interacted with the Indigenous peoples they encountered. They considered the lands from which the Indians harvested wild plants and animals to be unimproved and unowned.

1.2 Colonial Expansion

1.2.1 Conquest

Soon after Columbus landed in the West Indies in 1492, Spain came to dominate much of Central America, the Caribbean region, South America, and the southwest part of what later became the United States. Less successful efforts at colonizing South America by the Portuguese, French, Dutch, and British followed.

1.2.1.1 Latin America

When the Spanish arrived in the Western Hemisphere, they encountered a variety of cultural and ecological settings in the region that later became known as Latin America (Mexico, Central America, and much of South America and the Caribbean). Social organization ranged from small, kin-based groups to large, hierarchical societies. Indians grew crops on terraced slopes, in rain-fed fields, and in wetlands. They modified water availability to benefit agriculture by means of irrigation canals, dams, dikes, and ditches and grew a diverse assortment of crops unknown outside the Western Hemisphere, including tomatoes, potatoes, maize, and cocoa.

The conquistadors brought with them (unintentionally at first) microorganisms that caused diseases such as smallpox, typhus, and measles, to which the Indians had no immunity. Devastating mortality followed. The high death rate from introduced diseases, combined with losses from wars with the Spaniards, led to a drastic decline in the Indian populations (Crosby, 1986; Turner and Butzer, 1992).

Other species brought by the Spanish affected the fate of the Indians in less direct but nonetheless far-reaching ways. Reintroduced horses, which had gone extinct in the Americas at the end of the last ice age (Section 6.4.1.1), and cattle soon escaped captivity and established populations of *feral animals* (animals escaped from captivity or their descendants). They reproduced at such high rates that within a few decades there were herds of tens of thousands of animals (Crosby, 1972). Cattle supplied beef, hides, and tallow, which was made into candles that lighted the underground gold and silver mines.

The cattle had lasting ecological and economic impacts. They trampled fields and uprooted crops, contributing to overgrazing, erosion, and the spread of introduced plants. The decline in the Indigenous population made it easy for the Spanish to take over land and to justify doing so. Large farms and ranches replaced Indigenous agriculture in fields and within agricultural infrastructure that had been abandoned. Traditional agricultural knowledge was lost except in a few remote locations (Sluyter, 1996).

The Spanish conquistadores exported precious metals as well as products from native organisms. In Europe beans from cacao trees were used to make cocoa, which became a

popular beverage. Both *indigo*, a blue dye derived from a shrub that grew along the Pacific coast of Central America, and *cochineal*, a bright red dye extracted from scale insects that grew on cactus plants, were produced on plantations. The ecological impact of this production was modest compared to the plantations of introduced sugar cane, which required clear-cutting and used great amounts of wood for boiling down the sugar juice (Myers and Tucker, 1987).

1.2.1.2 North America

Indians in North America also traded with Europeans. In the northeast, they provided the Dutch, English, and French with beaver pelts – which were in demand for felt hats – as well as furs of other mammals. The resulting fur trade spread westward across North America. Because beaver ponds were easy to find, beaver were especially vulnerable to exploitation. When their populations plummeted as a result, many plants and animals associated with the wetlands created by beaver ponds declined (Box 11.5).

The Indians' hunting territories were part of a multifaceted system of property rights that varied from region to region. In southern New England, for example, Indian villages had collective sovereignty to the territory they used throughout a year. In addition to owning the animals they obtained in their hunting territories, families owned the crops they produced and products they gathered from the land (Cronon, 1983).

Europeans arrived with very different ideas about land ownership. The colonists believed that development of the land's resources legitimized ownership. According to their values, land belonged to those who labored on that land or who employed others to labor on the land. They viewed Indigenous hunting as recreation, not legitimate economic activity, and they considered the lands from which the Indians harvested wild plants and animals to be unimproved and unowned (Hurt, 1987).

Habitats were transformed as a result of this belief that landowners should increase the value of their land by using it to produce crops or livestock. The settlers cleared forests for farming and to provide fuel and timber. Americans consumed far more firewood in the New World than they had in Europe, where wood was scarce (Cronon, 1983). At first, this exploitation depleted forests in the eastern USA; later it spread to the Great Lakes region. As the supply of timber dwindled, forests even further west were cut. This process came to an end only when westward expansion was stopped by the Pacific Ocean. Changes in the intensity of resource use, in habitat structure, and in plant community composition followed each new wave of settlers.

Many Indigenous tribes in the United States signed treaties in which they ceded vast areas of their traditional territories but retained rights to fish, hunt, and gather in those territories (Section 9.6). In most cases, however, those rights were not respected.

1.2.1.3 Asia, Africa, and Oceania

The changes that occurred when colonists from Portugal, England, France, Belgium, the Netherlands, and Spain arrived in much of Asia, Africa, and Oceania were similar in many respects to those that followed colonization in the Western Hemisphere. The specifics differed with the varied cultural and ecological contexts, but some general patterns emerged.

Again, the ecological changes that occurred with colonialism resulted in large part from European assumptions about what constituted legitimate uses of nature. Exploitation of selected resources intensified, while customary uses were restricted. For example, colonial administrators in Kenya did not recognize native Maasai ownership of their lands because by European standards nomadic pastoralism did not improve the land (Collett, 1987). (The words nomad and nomadic are often used to imply aimless wandering, but nomadic peoples actually follow well-defined routes, although the pattern may vary from year to year depending on weather and available vegetation.)

Customary resource management systems were eroded, and profound ecological changes – including the depletion of resources critical for Indigenous peoples and the arrival of non-native plants, animals, and diseases – followed. Large areas of communally owned land were converted to plantations. Yet, as timber and wild plant resources declined and forest cover shrank, colonial concern about the need for conservation mounted and led to measures such as reserves designed to protect forests.

For the most part, the diseases that European colonists brought to Africa and Asia did not cause serious problems for Indigenous peoples. Rather, the reverse was sometimes true. The diverse pathogens and parasites in tropical Asia and Africa limited European expansion into those regions. Because the colonized lands had not been isolated from Europe in the way that they had in the Western Hemisphere, African exposure to European pathogens did not cause the kind of depopulation that occurred in North and South America. *Rinderpest*, a devastating virus of livestock and wildlife that was brought to North Africa by Italians at the end of the nineteenth century, was an exception (Section 10.1.5.2).

In contrast, the native peoples of pre-contact New Zealand and Australia had not been exposed to European diseases before Europeans arrived, and therefore they were vulnerable. Smallpox was particularly devastating to the Aborigines of Australia. For the Maori of New Zealand, tuberculosis, respiratory infections, and sexually transmitted diseases reduced the population (Crosby, 1986).

Rabbits were released on mainland Australia on Christmas Day in 1859 by a member of an organization dedicated to establishing European plants and animals abroad. They multiplied rapidly, as rabbits usually do. By overgrazing and suppressing the regeneration of many native plants, rabbits damaged soils and contributed to the decline and extinction of many native species in Australia (Williams et al., 1995). Those problems were exacerbated by introduced predators, such as foxes and feral cats (Caughley and Gunn, 1996).

1.2.2 Changes in Resource Use: Intensification and Criminalization

As with the fur trade in North America, the intensity of wildlife exploitation increased when Europeans colonized Africa. East Africans had a long history of trading ivory from elephant tusks, but in the latter half of the nineteenth century, the level of trade escalated. Africans began supplying ivory to commercial operators to meet British and American demand for knife handles, piano keys, combs, and similar items. As ivory became scarce,

missionaries, colonial administrators, and entrepreneurs traded buffalo and other wildlife to raise revenue for their African enterprises (MacKenzie, 1987).

Throughout the colonies, Indigenous resource uses were criminalized while colonial exploitation of trees and wildlife increased. Authorities in Africa and India forbade traditional hunting but permitted sport hunting. The turn of the nineteenth century in Africa witnessed the elevation of a mystique around hunting for sport, which came to be known as the Hunt. Colonial hunters and wealthy international adventurers killed to obtain skins, trophies, and horns as emblems of prestige (or, later, for museum specimens), yet the Hunt was said to embody ideals of sportsmanship (Manore, 2007). Game laws excluded Africans from hunting, although their skill as trackers was indispensable for a successful Hunt, and their labor as porters was essential to large safari parties. Theodore Roosevelt described the porters on his safari to Africa (which killed 512 animals) as “strong, patient, good-humored savages” (Roosevelt, 1910:94).

In South and Southeast Asia, protection of forest resources, rather than game, was the pre-eminent concern of colonial governments. Much communally managed tropical forest in India, Indonesia, and Indochina, as well as islands in the Indian Ocean, was brought under the control of the Dutch, British, and French East India companies to facilitate commercial timber production. Mixed forests were converted to plantations with single-species *stands* (collections of trees) of commercially valuable species such as ebony and teak. Local uses, except for harvests of some forest resources for customary subsistence, were forbidden. Unauthorized users became “poachers,” “squatters,” or “timber thieves” (Grove, 1990; Gadgil and Guha, 1995; Peluso and Vandergeest, 2001).

1.2.3 Colonial Reserves

As the effects of intensive resource use became evident, colonial scientists and administrators began to worry. They were uneasy about the fate of economically valuable resources, but their concerns also grew out of a growing recognition that high levels of resource exploitation, especially hunting and deforestation, had serious consequences.

In 1875, the professional hunter W. H. Drummond praised southeastern Africa as “the finest game country in the world,” but lamented that “day by day, almost hour by hour, and with ever increasing rapidity, the game is being exterminated or driven back.” He especially feared that the “wanton and wasteful wholesale destruction” of elephants for ivory could not “last much longer” (Drummond, 1875:viii, 220, 221).

By the late seventeenth century, scientists employed by the East India companies feared that colonial economic policies had harmful environmental effects. In addition to being concerned about timber famine and wildlife extinctions, they worried that soil erosion due to deforestation, especially at the headwaters of streams, was causing local climate change. These combined fears spearheaded conservation centered on designating forest reserves to reduce erosion and safeguard water supplies (Grove, 1992).

Similar patterns occurred in North America and Europe, where concerns about resource depletion contributed to the rise of conservation. We turn our attention to those changes next.

1.3 Changes from 1800 to 1950

1.3.1 Altered Habitats

During the initial colonial period in eastern North America, forests were considered a deterrent to progress. Clearing the forests was considered a prerequisite for taming the wilderness and improving the land. Later, during western expansion, trees were viewed as a resource for commercial exploitation. Little thought was given to future supplies. "The common assumption was that trees, like Indians, were an obstacle to settlement, and the woodsmen were therefore pioneers of progress" (Udall, 1963:67).

When the timber industry developed, a cut-and-take mentality of making a quick profit prevailed. Because forest land was cheap and harvesting trees did not require much investment, the timber business attracted entrepreneurs. With so much competition there was no incentive for conservation. Companies made quick profits and moved on, leaving large piles of dead wood behind. When that material dried, it was highly flammable, and when it burned it did so with unprecedented intensity (Hays, 1959). The capacity for forest regeneration was nil. Devastating forest fires followed in the wake of careless logging. In 1871, the Peshtigo Fire in upper Wisconsin and parts of Michigan consumed 1.5 million acres and killed thousands of people.

Similarly, minerals and oil were extracted using methods that involved making quick profits. In California in the 1870s, hydraulic mining of gold washed tons of soil and gravel downslope, causing problems for people living in the valleys below and irreversible ecological impacts upslope (Udall, 1963). In mining as in timber harvest, money could be made by those who extracted the resources before anyone else did, regardless of the waste or ecological damage that followed.

As settlers proceeded westward, many habitats, including forests, prairies, and wetlands, declined because they were converted to croplands or used for grazing. As livestock replaced native herbivores, problems from overgrazing developed. Cattle and "buffalo" (bison) had quite different ecological effects. Bison herds grazed an area intensively and then moved on, allowing the vegetation to recover, but livestock grazing is prolonged, especially if the animals are fenced in. Settlers were unfamiliar with the dry climate of the Midwest and failed to appreciate the potential impacts of overgrazing and loss of plant cover in such a setting. Furthermore, because the impacts of grazing are gradual, most people did not recognize what was happening until the effects on native vegetation were dramatic, soil erosion had become severe, and alien weeds were entrenched. (In a similar vein, colonial administrators and post-independence national governments in Africa did not recognize the importance the seasonal movements of large grazers for sustainable grazing regimes (Section 10.1.1.2).)

By the 1920s, thousands of homesteaders had moved to the Midwest to farm. Using mechanical tractors, they uprooted the native sod and planted crops. The severe droughts that occurred in the following decade led to an ecological and humanitarian crisis. Crops and livestock died, wind blew away the topsoil, and dust storms darkened the sky, resulting in a period that came to be known as the Dust Bowl. Unable to grow food or find jobs, hundreds of thousands of farmers and ranchers left their homes and migrated west

in search of work in the fields of California, a phenomenon that was recorded in photographs, books, and songs.

Some species such as the coyote benefited from the changes in habitats. However, the effects of habitat modification, increased exploitation, and predator control contributed to the decline and sometimes the disappearance of many native species.

1.3.2 Population Declines

1.3.2.1 Prairie Dogs and Ferrets

In open habitats of the midwestern USA, colonies of prairie dogs (small rodents related to ground squirrels) dug extensive underground burrow systems and lived in colonies covering as much as 100 ha. Because these rodents fed on grasses, ranchers viewed them as potential competitors of livestock. By the early 1900s, elaborate public and private poisoning programs were directed at prairie dogs (Nowak and Paradiso, 1983). As a result, their distribution and abundance declined, as did the black-footed ferret, a type of weasel that depended on them and became extinct in the wild in 1987.

1.3.2.2 Predators

Prairie dogs were not the only animals that competed with the settlers' livestock. Many species of predatory land mammals and birds were systematically killed in efforts to minimize conflicts with livestock and people (Section 4.3.1). Hawks, owls, wolves, foxes, bears, and wild members of the cat and weasel families declined throughout the USA and Canada (as well as Europe and Russia) because of predator control programs.

1.3.2.3 Bison

An estimated 50 million bison roamed the plains of North America when Europeans arrived. Because of their great numbers, bison were easy for market hunters to find and to kill. Much of the carcass was usually wasted; often only the tongues and hides were taken (Hornaday, 1887).

The elimination of bison was, in part, motivated by politics. The persistence of their massive herds was not consistent with the dominant vision of how the frontier should develop.

Because of their numbers and mass, these animals had a pivotal role in the ecology as well as the material and spiritual culture of the Great Plains Indians. The bison provided a prey base for predators; influenced nutrient cycling through their grazing, defecation, and urination; and modified the physical structure of the vegetation by trampling and wallowing. They also provided food, clothing, and implements for Native Americans and featured prominently in rituals and beliefs.

But the bison ate prairie plants that ranchers wanted for their cattle. In 1874, Representative O. D. Conger of Michigan argued against a bill in the US Congress that would have limited the killing of bison, contending that the herds were incompatible with settlement because they competed with sheep and cows. He suggested that the bill granted a "privilege"

to the wild, savage Indian that is not given to the poor civilized settler [The buffalo] eat the grass. They trample upon the plains upon which our settlers desire to herd their cattle and their sheep They range over the very pastures where the settlers keep their herds of cattle and sheep to-day. They destroy that pasture. They are as uncivilized as the Indian.

(Congressional Record, 1874:2107)

Some government officials wanted to reduce bison populations for the specific purpose of subjugating native peoples of the plains. The explicit connection between eliminating bison and Indians was expressed in 1874 by Congressional Representative James Garfield of Ohio (who was later elected president of the USA) commenting on the same bill:

The best thing which could happen for the betterment of our Indian question ... would be that the last remaining buffalo should perish So long as the Indian can hope to subsist by hunting buffalo, so long will he resist all efforts to put him forward in the work of civilization The Secretary of the Interior said that he would rejoice, so far as the Indian question was concerned, when the last buffalo was gone.

(Congressional Record, 1874:2107)

Congress did pass the bill, but President Grant failed to sign it. By 1890, there were fewer than 1,000 bison in North America. Most of those were in Canada.

The bison had declined in the face of market hunting. However, there were also other circumstances that contributed to the bison's decline. Competition with introduced horses, diseases transmitted to bison by livestock, and drought all had negative impacts on bison populations (White, 1991).

Like its American relatives, the European bison, or wisent, barely escaped extinction. Hunting combined with conversion of forested habitat to cropland contributed to the wisent's decline. By the early twentieth century it survived only in Central Europe, and by 1919 the species was extinct in the wild (although a small number of individuals survived in zoos). It has since been reintroduced in the wild (Nowak and Paradiso, 1983).

1.3.2.4 Marine Mammals

Marine mammals (whales, sea otters, seals, and walrus) also declined in the face of intense exploitation.

Seals. Seals and walrus come ashore to breed, where they are vulnerable to exploitation because they concentrate in large groups and cannot move quickly. Prior to the eighteenth century, many coastal peoples exploited seals in the North Pacific, the North Atlantic, and the coast of the Mediterranean Sea for their meat, blubber, skins, bone, and – in the case of the walrus – tusks. In the folklore of Scotland and the islands of the North Atlantic, *silkies* – legendary creatures that are seals in the sea and transform into people on land – figure prominently.

In the late eighteenth century, a thriving trade in seal pelts developed. By the end of the nineteenth century, many commercially hunted species of seals had declined markedly in both the northern and the southern hemisphere, and entire *rookeries* (breeding colonies) had been eliminated (Box 3.3). At that point two factors came into play that probably saved several seal species from extinction. First, as it became harder to find

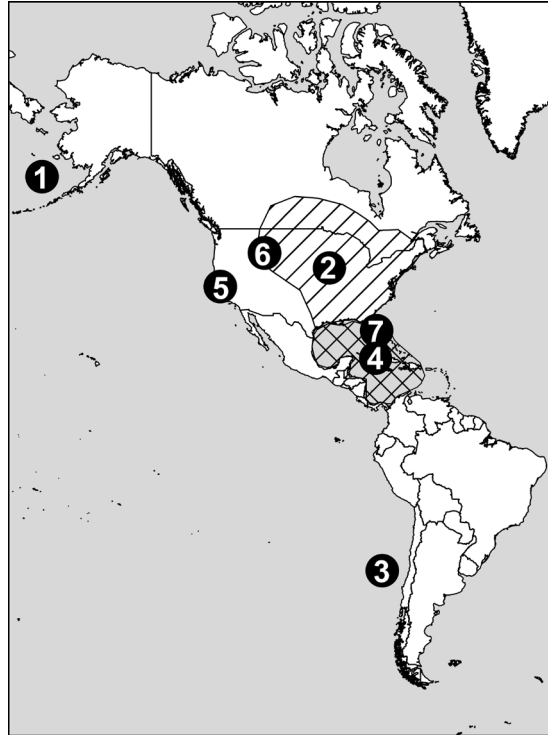


Figure 1.2 Locations of: 1, northern fur seal rookery, Pribilof Islands, Alaska; 2, extinct passenger pigeon, North America (hatched area); 3, extinct Chilean sandalwood, Chile; 4, range of extinct Caribbean monk seal, Gulf of Mexico and Caribbean Sea (cross-hatched area); 5, extinct Xerces blue butterfly, San Francisco; 6, Yellowstone National Park; 7, Pelican Island National Wildlife Refuge, Florida. Map created by Eva Strand using Esri, DeLorme World Countries Generalized Data & Maps for ArcGIS 2013, with permission.

seals, commercial exploitation dwindled, a phenomenon known as *economic extinction* (see *Q1.1*). In addition, the demand for seal oil shrank as alternative sources of fuel were developed.

The fate of the northern fur seal illustrates the dynamics of intensive commercial exploitation. This species breeds on the Pribilof Islands, a chain of islands stretching across the North Pacific (Figure 1.2). After the Russian explorer Gerassim Pribilof arrived at the breeding colonies in 1786, many small companies began to kill fur seals for their pelts. The number of animals they took is not known, but between 1786 and about 1820 the fur seal population declined precipitously (Baker et al., 1970; Gentry, 1998).

Measures to limit exploitation were rarely initiated by private commercial interests, but the Russian American Company, which held the concessions for sealing on islands where northern fur seals bred, was an exception. Sometime around 1834, the company began prohibiting the killing of females on some of the islands where they were harvested. Under this early management plan, the herd increased from about 300,000 animals to over 2 million in less than 50 years.

Although limitations on the seal kill worked for a while, changing market conditions prevented a prolonged recovery. In the 1860s, in response to a rise in the price of pelts, commercial sealers undertook *pelagic* (open ocean) *sealing*. This type of harvest was extremely wasteful, because the number of animals killed far exceeded the number retrieved. Many animals that were killed sank and were lost; others were wounded and died later. Unlike land-based sealing, where males could be distinguished from females by their size, pelagic sealing killed both males and females. Many of the females were nursing pups, which also died when their mothers failed to return.

In the early twentieth century, Japan began pelagic sealing, and a second serious decline in northern fur seal populations followed. By 1910, the species was down to about 10% of its 1867 level. (See Section 1.5.3 for information on how this situation was addressed to restore fur seal populations.)

Sea otters: Unlike seals and whales, sea otters rely on thick fur rather than blubber for insulation. Their pelts were thus very valuable. From the 1740s on, Russians hunted sea otters, first in the North Pacific and later along the coast of North America from Alaska to California. Later the Spanish, British, and Americans also killed sea otters. International competition created an obstacle to conservation. While Russia restricted its hunts in some places, other nations continued to deplete otters in those areas.

Whales: The story of whale exploitation is similar. Prior to the onset of whaling on the open ocean, many Indigenous peoples along ocean coasts killed whales for subsistence from small boats or used products from whales stranded on beaches. (Some cultures continue traditional whale hunts today (Section 12.6.1).) The remains of combs, keys, knife handles, and other objects made from the bones of whales thousands of years ago have been found in Scotland and other islands of the North Atlantic.

When Europeans arrived in New England, they established a prosperous commercial whaling industry. Before the age of modern chemistry, industrial whaling provided many products. Whale oil was a valuable source of light until petroleum became available. *Ambergris*, a substance formed in the intestines of sperm whales, was used as a fixative for perfumes. *Spermaceti*, a waxy substance found in the large reservoir at the front of the sperm whale's head, was valued as an industrial lubricant. Whale ivory was obtained from the teeth and jaw bones of toothed whales such as the sperm whale and the narwhal.

Blue, fin, humpback, gray, right, minke, and bowhead whales are baleen whales. They lack teeth but have fringed plates (*baleen*) that hang from their upper jaws (Figure 1.3A). When a baleen whale opens its mouth, water flows in, and the soft tissue of the lower jaw expands (Figure 1.3B). The whale then closes its mouth part way and raises its tongue. This allows water to squirt out while the baleen acts as a giant sieve, filtering food organisms from the water.

Baleen provided a flexible, springy, strong material that was used for many items made today from steel or plastic (Figure 1.3). Also known as *whalebone*, baleen formed the stays of women's "whalebone" corsets.

In the eighteenth century, a profitable commercial whaling industry developed off the island of Nantucket, Massachusetts. When a whale was sighted from a whaling ship, a few sailors (most of whom were Wampanoag Indians forced to work because of debt-servitude)

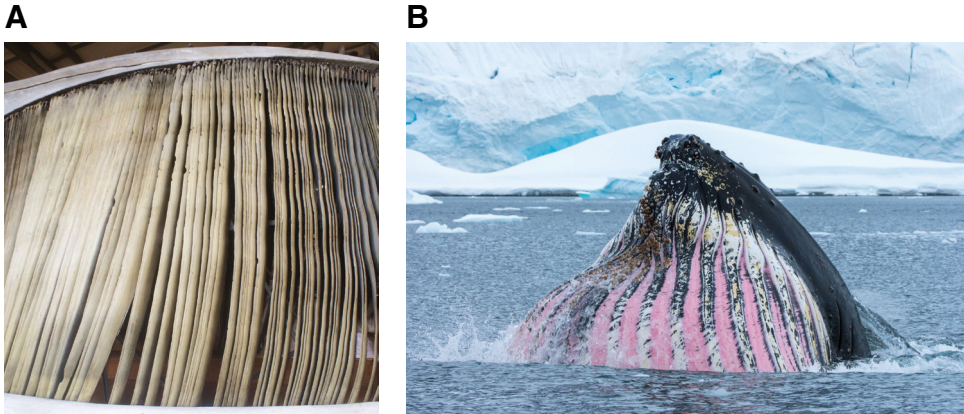


Figure 1.3 (A) Baleen hanging from the upper jaw of a baleen whale. The plates act as a giant filter to strain small marine organisms from seawater. Credit: Kevin Schafer / Moment Mobile / Getty Images. (B) Humpback whale feeding with mouth expanded to take in water. Credit: Adam Cropp / Moment / Getty Images.

pursued it in a small boat (Philbrick, 2001). If the sailors succeeded in harpooning the whale, it thrashed about, dragging the small boat and its crew along, an experience that became known as a “Nantucket sleigh ride.” Often the men drowned before the wounded whale died. Sperm, bowhead, and right whales were taken using this method. Those species could be handled from small boats because their carcasses float.

In 1864, a Norwegian captain invented a cannon-powered harpoon that exploded after it entered a whale. This Foyn gun was much more effective at killing whales than a hand-held harpoon. Armed with this technology, whalers became more efficient at finding, killing, and processing whales. As a result, populations of all the large whale species plummeted to low levels. Several species became so rare that whalers rarely encountered them, but the pursuit of other kinds of whales continued.

In 1931, in response to the decline and near extinction of large whales brought about by unregulated exploitation, a Convention (treaty) for the Regulation of Whaling was signed by 26 nations. Fifteen years later, the convention established the International Whaling Commission (IWC) to regulate commercial whaling in order to protect the supply of whales for commercial whaling (Section 7.3.1).

Most nations that conducted commercial whaling in the past now abide by the IWC’s moratorium on commercial whaling, but some exempt themselves from it, and others continue killing whales for research, which is not regulated by the IWC.

1.3.2.5 Colony-Nesting Birds

In the last half of the nineteenth century, women’s hats containing ornate feathers – and even whole, mounted birds – were fashionable in North America and Europe. As a result, a thriving trade in feathers, known as the plume trade, developed. Large numbers of many species that nested colonially – such as herons, grebes, terns, ibises, and

egrets – were killed for their plumage. Like the bison, their tendency to concentrate in groups made these birds vulnerable to exploitation (Section 6.5.1.1). Populations of colony-nesting birds declined dramatically because of this exploitation. (We will see below that the plume trade was a major impetus for the establishment of the first national wildlife refuges in the USA.)

1.3.3 Extinctions

Some species were not as lucky as bison, beaver, and fur seals. Certain characteristics, such as limited geographic distribution and defense strategies that worked against nonhuman predators but not against people, made these species especially vulnerable to extinction. Market hunting, efforts to control predators and pests, habitat alteration, and the arrival of non-native species were usually the circumstances that precipitated the declines, however.

1.3.3.1 North America's Passenger Pigeon

In the middle of the nineteenth century, the passenger pigeon may have been the most abundant bird on earth. It was present throughout much of eastern North America (Figure 1.2) in such great numbers that it was difficult for people to imagine its disappearance. The birds traveled in massive groups, accounts of which are so amazing that they might seem exaggerated if they were not so well documented. The ground underneath roosting flocks appeared to be covered with snow because of a thick layer of droppings, and it was common for tree trunks and limbs to break under the birds' weight. In 1806, the ornithologist Alexander Wilson estimated that a flock he saw in Kentucky contained over 2 billion birds. In 1813, the naturalist John James Audubon reported seeing a flock on the Ohio River that obscured the sun at midday (Trefethen, 1975).

By forming such large groups, it is likely that the passenger pigeon was able to overwhelm animals that preyed on it. Although predators were attracted to the pigeons' roosting and breeding aggregations, there were so many birds that predators could not eat them all, and large numbers of pigeons always escaped. This is termed *predator saturation*. Furthermore, the flocks never stayed in one place long enough for predators to increase to levels that would exert sustained pressure (Blockstein and Tordoff, 1985).

Although the enormous flocks were an effective *adaptation* (a trait that is favored by natural selection (Section 6.1.1)) to predation by wild animals, the flocks made the birds especially vulnerable to human predators. The passenger pigeon was a market-hunter's dream. It took little effort to find and to kill large numbers of birds. Professional hunters trapped them in baited nets capable of killing hundreds of birds at a time. Local hunters shot nesting birds and took young from the nest, sometimes killing virtually all the young from a nesting colony.

Birds could be shipped by rail to markets in distant cities. In 1878, hunters in Michigan took over a million birds from the last large nesting colony. In another example of economic extinction, commercial killing stopped when the birds became too scarce to hunt profitably, but unfortunately by that time it was too late for the species to recover. The last individual died in the Cincinnati Zoo in 1914.

The decline of the passenger pigeon was remarkably abrupt. Hundreds of millions of birds persisted into the 1870s, but by the 1890s they were very rare, and two decades later they were extinct. How was it possible for a species that had been so abundant to go extinct so quickly?

To answer this question, it is necessary to understand how the ecology of the passenger pigeon made it vulnerable in spite of the enormous size of its population. This species occurred only in the deciduous forests of northeastern North America. It fed on acorns, beechnuts, and chestnuts, which are produced by *mast trees*, trees that produce fruits and seeds erratically. Every few years, the different species of mast trees throughout a region produced abundant seed crops all at once. This is thought to be adaptive for the tree species that produce mast because the passenger pigeon and other seed-eating species such as squirrels could not consume all the seeds that were produced in a single mast season, so some survived and germinated. Furthermore, just as the squirrels and pigeons could not eat all the seeds of the trees they fed upon, the predators could not eat all the squirrels and pigeons.

Because the availability of these foods was unpredictable, passenger pigeons had to search wide areas to find food. The large size of their flocks may have allowed them to scan vast expanses of the landscape. When some of the birds detected food, they would call to the other flock members. Eventually, when the pigeon populations were reduced by a combination of hunting and habitat loss, their ability to locate food was probably compromised, even though the flocks were still large. It seems likely that their dependence on erratically available food supplies which could only be found by enormous aggregations of birds made passenger pigeons uniquely vulnerable to the combined effects of exploitation and deforestation (Bucher, 1992).

Like the bison, the passenger pigeon might have been intolerable to settlers. It is doubtful whether the landscapes of the eastern and midwestern USA could have supported passenger pigeon flocks along with intensive agriculture and urbanization.

1.3.3.2 Giant Tortoises on Mauritius

Mauritius (Figure 1.1) is a group of oceanic islands in the Indian Ocean east of Madagascar. When the Dutch claimed it in 1598, they found two species of slow-moving, long-lived land turtles: a large, high-backed, flat-shelled tortoise and a smaller, domed tortoise. Both were *endemic* to Mauritius and nearby islands (Griffiths et al., 2010). (The meaning of the term endemic in ecology is different from its meaning in medicine. In ecology, a species that is endemic to a region is not found anywhere else. In medicine, a disease that is endemic to a place is regularly found in that place but is not necessarily restricted to it) (*see Q1.2*).

Ships from several maritime nations stopped on Mauritius regularly to stock up on food, and the Dutch established short-lived settlements for the purpose of harvesting ebony trees. According to an account by a Portuguese missionary who visited the island, the tortoises could “easily carry a man on their back for some time. They are ugly and deformed creatures, whose carapace, hard though it is, can nevertheless be shot through by a bullet, as we have had occasion to test out” (Cheke and Bour, 2014:47).

Before people arrived, adult tortoises had no predators. Consequently, they did not flee from or avoid people who came to the island. Because they were easy to find and kill, the

tortoises were heavily exploited for their meat and their fat, which was valued for making candles and was considered “superior to the best butter” (Cheke and Bour, 2014:48). Thirty to 40 animals were needed to obtain a pint of grease. Often only the fat was used, and the carcasses were left to rot or were fed to pigs.

Introduced pigs devastated the tortoise populations, eating their eggs as they were laid. When cats were introduced, predation became even more intense. Successful tortoise reproduction had probably ceased by the end of the 1600s, but some individuals might have lived for many decades. It is unlikely that any survived on Mauritius past the 1620s.

1.3.3.3 Chilean Sandalwood

The Chilean sandalwood was a tree species endemic to the San Fernández Islands (Figure 1.2). This small archipelago of three volcanic islands in the South Pacific became known to the Western world in 1574 when the Spanish explorer Juan Fernández encountered it on a voyage west of Chile. Subsequently, a Scottish naval officer was marooned on one of the islands from 1704 to 1709, an experience which may have provided the inspiration for the novel *Robinson Crusoe*.

We know from herbarium specimens and remnants of wood collected at known locations that the Chilean sandalwood was present on the two largest of the San Fernández Islands. British and American whaling ships often stopped there to make repairs and take on firewood. As a result, native trees on the lower slopes declined, and severe erosion developed. Chilean sandalwood was probably quite common until the eighteenth or nineteenth century when it was depleted by logging.

The reddish heartwood of this plant was used for handicrafts and sculptures and was exploited for its fragrant oil. It was last recorded in 1908 by a Swedish botanist who photographed what may have been the last living member of this species. That plant is believed to have died by 1916, although pieces of Chilean sandalwood were still in circulation as late as 1996 (Stuessy et al., 1998).

1.3.3.4 Tasmanian Wolf

The Tasmanian wolf or Tasmanian tiger was a carnivorous *marsupial* (pouched mammal) of the Australian region. Although it is not closely related to dogs and true wolves, the Tasmanian wolf's teeth, build, and feet are remarkably doglike (Figure 1.4). Its scientific name means “pouched dog with a wolf head.” This similarity in unrelated species is known as *convergent evolution* (Box 12.5).

Tasmanian wolves were widespread in Australia and New Guinea until about 3,000 years ago, but subsequently they became extinct everywhere except on the island of Tasmania (Figure 1.1). It is likely that their demise in those regions was due to competition with the dingo (Australian wild dog), which was introduced by Aboriginal hunters about 10,000 years ago (Archer, 1974). Dingoes spread throughout most of the Australian region, but they did not become established in Tasmania.

When Europeans arrived in Tasmania and began raising sheep, predator control programs were initiated. Tasmanian wolves were shot, trapped, and poisoned. Between 1888 and 1909, the government paid bounties for over 2,000 individuals, and others were killed

Tasmanian tiger

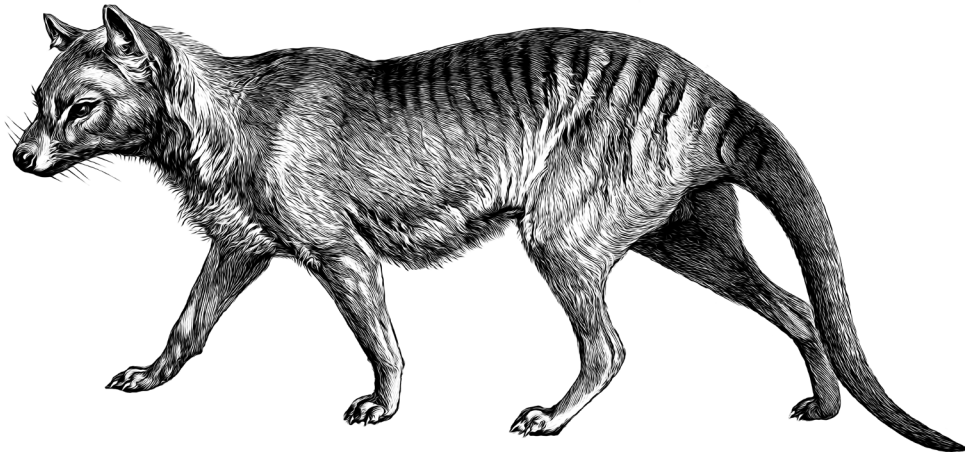


Figure 1.4 Tasmanian wolf. Antique engraving. Credit: mikroman6 / Moment / Getty Images.

for private bounties or for income from selling their pelts. Habitat loss, competition with dogs, and disease may have contributed to their decline (Caughley and Gunn, 1996). By 1905 the Tasmanian wolf population had declined markedly, and by the 1930s the species was extinct (Nowak and Paradiso, 1983).

1.3.3.5 Caribbean Monk Seal

The Caribbean monk seal once occurred mainly in the Caribbean Sea and the Gulf of Mexico, but its range also extended south to South America and north to the coast of Georgia (Lowry, 2015) (Figure 1.2). It was one of three species of monk seal. Like other seals, monk seals periodically came ashore on coastlines and islands to rest and breed. Unlike other seals, however, monk seals lived mainly in tropical waters. Authorities disagree on whether the Caribbean monk seal was rare before Europeans arrived or was abundant but subsequently declined because of exploitation.

Humans and sharks were the only major predators of the Caribbean monk seal. Prior to contact with Europeans, Indigenous peoples sometimes used this species, but it was not a major target of exploitation. Soon after Columbus encountered Caribbean monk seals in 1494, Europeans began killing them for food. By the late 1600s, many seals were being killed for their skins and oil (much of which was used to lubricate machines on sugar plantations). Still later they were killed by fishermen concerned that they might be competing with them for fish, and this species was also taken for museum specimens and public displays. It was rare by the late 1880s, although Caribbean monk seals persisted at least until 1952, when a small colony was sighted at a group of coral islands between Jamaica and Honduras. Subsequent searches of the region did not locate any individuals, although there were unconfirmed sightings from time to time (which were most likely a different species).

1.3.3.6 *Xerces Blue Butterfly*

The Xerces (ZER sees) blue butterfly occurred only in and around San Francisco, California (Figure 1.2), where it was restricted to well-drained soils of coastal sand dunes. Within its restricted geographic range, it had narrow food preferences. Typically, this species occurred near mat-forming patches of a plant known as deerweed, beneath Monterey cypress trees. Females laid eggs on deerweed or yellow bush lupine. After the eggs hatched, the larvae (caterpillars) fed on those plants until they formed pupae. After 10 to 11 months, adult butterflies emerged from the pupae. Although adult butterflies can fly, caterpillars cannot, so the larvae could not move from one host plant to another. For this reason, they were dependent for food on the host species on which the eggs were laid. This put the species at risk.

As the city of San Francisco developed, habitat for the Xerces blue and its host plant shrank. By 1919, these butterflies were seen in an area only 21 m wide by 46 m long. The last known specimens were collected in 1941. Many subsequent searches of its habitat failed to turn up any more individuals of this species. The immediate cause of the Xerces blue's extinction was disturbance due to urban development, but the underlying circumstances that made it vulnerable were its narrow *geographic range* (the region over which it was distributed) and specialized food requirements.

Data from field and laboratory studies of the Xerces blue indicated that, like many of its close relatives, the Xerces blue formed a close association with ants. However, the species became extinct before it was possible to get additional information about this interaction.

These examples illustrate how the depletion of wild plants and animals and their habitats set the stage for conservation aimed at addressing the resulting problems.

1.4 Diagnosing the Problem

Habitat modification and species declines fostered the development of conservation sentiment during the last half of the nineteenth century in the USA and in many parts of the Western world. Among those who worried that economically important resources would soon be exhausted, fears of a timber famine, along with concerns about the fate of water supplies and wildlife, were prevalent (Hays, 1959). In his influential book, *Man and Nature: Or, Physical Geography as Modified by Human Action*, originally published in 1864, George Perkins Marsh warned of "desolation ... unless prompt measures are taken to check the action of destructive causes already in operation" (Marsh, 1965:201). Similar dire warnings appeared in numerous popular articles with titles such as *Timber Waste: A National Suicide* (Pisani, 1985). In addition to those who warned that resources were being used at a rate that could not be sustained for long, there were others, such as John Muir (Preface) who feared that the beauty of the natural world would be destroyed. Those voices emphasized the importance of protecting places with aesthetic and spiritual value.

The immediate causes of these problems seemed straightforward: high rates of use, waste, and lack of regard for preserving or restoring valued habitats. Better management of living natural resources was clearly needed to stem the tide of declining populations and habitats. The dominant view was that economically valuable species should be managed to

support efficient economic growth, although a minor theme that emphasized strict preservation also emerged. We consider that thread first.

1.5 Response

1.5.1 Reserves

Some reserves prohibit or severely curtail the removal of resources within their borders, whereas others allow managed extraction. The first category includes national parks (which generally exclude most forms of consumptive resource use) or other areas that are set aside to protect their scenic values or the habitats and populations within their borders.

1.5.1.1 *Strict Protection within Reserves*

In 1864, US Senator John Conness introduced a bill to the US Senate proposing that Yosemite Valley in the Sierra Nevada mountains be granted to the state of California. In his comments to the Senate, Conness argued that the lands under consideration constituted “perhaps, some of the greatest wonders of the world” (Congressional Globe, 1864:2300). When President Lincoln signed the bill, Yosemite became the first place that the US government had set aside to preserve scenic beauty for “public use, resort, and recreation” (Yosemite Valley Grant Act of 1864).

Yosemite was not the nation’s first national park because it did not become part of the national park system until 1916. That distinction belongs to Yellowstone National Park, which encompassed parts of the Wyoming and Montana territories (Figure 1.2) that were set aside by Congress “as a public park or pleasuring-ground for the benefit and enjoyment of the people” in 1872 (Yellowstone National Park Protection Act of 1872). The Indigenous peoples whose territories encompassed Yosemite and Yellowstone were prevented from using those lands in the designated parks, an issue that received little attention from conservationists for about a century (Spence, 1999).

Like Yosemite, Yellowstone National Park was set aside to preserve scenic and geologic wonders. Both were beautiful places at high elevation locations that were regarded as economically worthless. As far as Congress was concerned, setting them aside did not entail any economic sacrifice. In Senator Conness’s recommendation that Yosemite be preserved, he argued that it was “for all public purposes worthless” (Congressional Globe, 1864:2300). (Recall from the Introduction, however, that within a few decades Congress would change its mind about the value of Yosemite’s resources.)

The bill that set aside Yosemite Valley also authorized private individuals to apply for leases to build and operate tourist accommodations within the park. Ironically, John Muir, the wilderness enthusiast who championed the natural values of Yosemite, disapproved of some forms of enjoyment of nature. He wrote of yearning to live in the Sierra Nevada mountains “like the wild animals, gleaning nourishment here and there from seeds, berries, etc., sauntering and climbing in joyful independence of money or baggage,” and disparaged the “glaring tailored tourists ... that frightened the birds and squirrels” (Muir, 1911:4,79).

The designation of lands for the benefit of the public raised thorny questions. Can the public enjoy natural places without harming them? What commercial development of those places should be permitted? Are some forms of enjoyment of natural places more valid than others?

1.5.1.2 Regulated Resource Use within Reserves

After the Civil War, concern increased about whether America's living natural resources could sustain the levels of harvest to which they had been subjected. Beginning in the 1890s, substantial areas of public land in the USA were set aside for regulated resource use within their borders. The resources of concern included timber (national forests), wildlife (national wildlife refuges), and livestock forage (lands managed by the Bureau of Land Management).

In 1903, Pelican Island, off the coast of Florida, became the first national wildlife refuge in the USA (Figure 1.2). It was set aside by President Theodore Roosevelt to protect birds that were hunted for the plume trade. Additional land was rapidly added to the refuge system. By the end of 1904, Roosevelt had designated 51 refuges.

Because the word "refuge" implies a safe place or sanctuary, people are often surprised to learn that hunting and fishing are allowed in many national wildlife refuges. The earliest national wildlife refuges in the USA were indeed intended to serve as sanctuaries for birds targeted by plume hunters. Many of the refuges that were subsequently set aside, however, were established for game species such as *waterfowl* (ducks, geese, or swans) or ungulates, with the explicit purpose of providing hunters and fishers with a supply of game during regulated seasons.

The Bureau of Land Management (BLM) is another federal agency in the USA that administers large areas of federal land on which extractive activities, including grazing, timber harvest, and mining, are permitted. This agency was established in 1946 to take over the administration of *rangelands* (lands that are unsuited for cultivation but produce forage for livestock or wildlife). The BLM manages more than half the federal lands of the United States.

1.5.2 The Rise of Conservation Science

The designation of public lands for regulated use created a need for scientific information to guide conservation within those lands. The need for information to guide water management was particularly pressing in the American West, where most public lands were located. Scientific study of those lands began in 1879. Like colonial scientists in the tropics, Western scientists and irrigators soon realized that forests were critically important for protecting water quality.

1.5.2.1 Forestry

The first American national forests were designated in 1891. Before leaving office, President Harrison set aside 526,000 ha of forest reserves in the American West. Early forest managers drew upon but modified an older tradition of European forestry. Europe's

scientific approach to forestry involved intensive management of scarce, privately owned resources. For example, in nineteenth century Germany, stands of spruce were planted and thinned, resulting in *monocultures* (holdings dominated by a single species) of small, symmetrical trees of the same species and age.

American resource managers recognized that European-style intensive management of public forests would not be accepted by the American public. But although American foresters rejected the European approach as too unnatural, they too saw themselves as analogous to farmers. In their view, agriculture and natural resource management differed only in the degree of domestication of the product. Both manipulated critical factors to enhance production. This was to be done in a regulated fashion that would ensure a continuous flow of products.

In 1898, Gifford Pinchot, a wealthy New Englander with European training in forestry, took office as the US Department of Agriculture's chief forester. Scientists and foresters in the US government shared a commitment to rational, efficient management of water resources and forests to promote economic growth. As a result of Pinchot's advocacy, the concept of regulated use was adopted as the guiding principle of national forest management. Forests were to be managed to maximize the amount of wood that could be produced while ensuring a future supply. The goal was *sustained yield*, the harvest of a renewable resource at a level that could be maintained over time. For yield to be sustainable, the rate at which plants or animals are harvested must not exceed the level at which they grow back, and the harvest must not harm other species or ecosystem processes. If these assumptions are met, then sustainable harvest is possible (though it is not guaranteed) unless conditions change. Historically, the implied assumption of no effects on non-target species has rarely been tested.

In response to wasteful practices of the day, and convinced that commercial exploitation of forests was inevitable, Pinchot argued that "the job of the forester was not to stop the ax but to regulate it" (Pinchot, 1947:29). "The purpose of Forestry, then, is to make the forest produce the largest amount of whatever crop or service will be most useful and keep on producing it for generation after generation of men and trees" (Pinchot, 1947:32).

Under Pinchot's leadership, a cadre of idealistic, college-educated young men set out to save America's forests from timber barons through a program of scientific, rational, and efficient harvest management. Pinchot and these young men saw themselves as reformers, curbing corrupt special interests and safeguarding the nation's forests for future use. By studying the growth rate and abundance of each tree species, foresters would scientifically determine appropriate harvest levels. Regulated timber harvests would replace rapacious looting of the forests. Their passion was shared by Pinchot's boss and close friend President Theodore Roosevelt.

According to scientific forestry of the day, disturbances that damaged valued species should be eliminated. One of the young forest managers in the early twentieth century was a midwestern lover of the outdoors named Aldo Leopold. Like his colleagues, the young Leopold focused on protecting resources from whatever destroyed them. Excluding fire from forests meant saving timber. In an essay written in 1920, Leopold stated that "Piute [Paiute Indian] forestry," the practice of setting frequent, low-intensity fires,

would “ultimately destroy the productiveness of the forests on which western industries depend for their supply of timber” (Leopold, 1920:12). Similarly, Leopold’s contemporary William Greeley wrote in 1920 that the best way to manage forests was “to keep fire out of the woods” (Greeley, 1999:33).

Leopold and Greeley dismissed the idea that Indians had any insight into forest dynamics. “It is, of course, absurd to assume that the Indians fired the forests with any idea of conservation in mind” wrote Leopold (Leopold, 1920:13). Likewise, Greeley disparaged the idea that the Indian “fired the forests regularly ... because his nature lore taught him that this was the way to prevent the ‘big’ forest fire” (Greeley, 1999:34). These views on light burning reveal the assumption that Native Americans were incapable of managing their environment wisely (*see* Q1.3). This mindset had far-reaching consequences.

1.5.2.2 Game Management

The discipline of game management in North America was launched in 1933 when Aldo Leopold, at that time a Professor of Forestry at the University of Wisconsin, published a text on the subject (Leopold, 1933). (The term *game management* eventually came to be called wildlife management, and the term wildlife itself expanded over the decades. At first, it was used to refer to hunted species; later it came to mean all terrestrial vertebrates. In current usage, the term wildlife can refer to all forms of wild organisms, including animals, plants, and microorganisms, although it is commonly used to mean animals, especially mammals and birds).

Leopold defined game management as “the art of making land produce sustained annual crops of wild game for recreational use” (Leopold, 1933:3). The comparison to agriculture was explicit: “Like the other agricultural arts, game management produces a crop by controlling the environmental factors which hold down natural increase, or productivity of the seed stock” (Leopold, 1933:3). Like foresters, wildlife managers emphasized regulated use of resources through manipulation of the environment to maximize the productivity of desired species and minimize undesirable species. (However, Leopold later came to believe that predators play an important ecological role (Section 4.3.3).)

1.5.2.3 Range Management and Soil Science

Range management differs from the management of forests or game because it concerns domestic animals that are produced from wild forage, whereas foresters and game managers regulate harvests of wild plants and animals directly. But range management is similar to those disciplines in that it was formed to address utilitarian concerns. Like early foresters and wildlife managers, the first range management professionals emphasized maximizing productivity, specifically the productivity of wild crops. A US Department of Agriculture bulletin published in 1926 stated that “more and better forage, as well as the maximum production of beef, wool, and mutton, is a primary object of grazing management” (Sampson, 1926:1).

Like range management, soil science addresses the manipulation of a natural resource (soil) for the purpose of producing domesticated species (agricultural crops). Farmers in many parts of the world had been making observations about agricultural practices that affected their soil for millennia, but it was not until the nineteenth century that formal

study of soils developed (King, 1907). Scientists from Germany, Russia, and Denmark synthesized concepts and methods from geology, chemistry, physics, and microbiology in order to study the formation and development of soils and to classify soils according to their physical properties and potential uses. In 1933, the US Soil Erosion Service (later renamed the Soil Conservation Service and even later the Natural Resources Conservation Service, NRCS) was formed in response to the soil erosion crisis of the American Dust Bowl. The NRCS works primarily with private landowners, providing assistance regarding soil erosion, fertility, and other technical issues related to soil conservation (Section 3.4).

1.5.3 Regulations

Jurisdictional problems confound efforts to manage species that move around. In the USA, if a plume hunter killed birds in violation of a state's laws and transported the feathers to another state, neither that state nor the federal government had jurisdiction. This situation changed with the passage of the Lacey Act in 1900, which outlawed interstate shipment of any wild birds or mammals or their parts or products (including feathers and eggs) that had been taken in violation of state laws.

Management of mobile wild animals that move across international boundaries is even more complicated. In 1911, the USA, Imperial Russia, Japan, and Britain (for Canada) signed a treaty regulating commercial harvests of northern fur seals. Under the provisions of this treaty, the USA and Russia, which contained breeding islands, shared the sealskin take with Canada and Japan, which agreed to stop pelagic sealing. After the treaty was signed, fur seal populations rebounded, reaching a high in 1941 (Bailey, 1935; Gentry, 1998).

Efforts to conserve migratory birds ran into similar problems. (Migrating animals make predictable annual round-trip *migrations*, in contrast to human migrations, which are usually one-time events.) By the late 1890s, populations of North American waterfowl were down to very low levels because of a combination of drought and market hunting. But, since waterfowl migrate long distances between their breeding and their wintering grounds, governments were reluctant to pass protective legislation limiting hunting within their own borders. People reasoned that if they did not shoot the migrants, someone in another country, state, or province would.

An attempt to solve this problem in the USA with federal legislation was challenged in the courts as a states' rights issue. But before the Supreme Court decided the case, the problem was circumvented in 1916 by the Migratory Bird Treaty between the USA and Canada, which established restrictions on the taking of migratory game birds such as waterfowl. The USA subsequently signed similar treaties with Mexico, Japan, and the Soviet Union.

We have seen in this chapter how historical conditions gave rise to utilitarian conservation primarily aimed at managing supplies of economically valuable species. The next three chapters describe the central concepts of this approach (Chapter 2), and the principal strategies for accomplishing its goals (Chapters 3 and 4).