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12

Wolves and Humans

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TRY TO IMAGINE a small group of wolves sitting at a table engaged in vigorous debate. These wolves are from various parts of the globe and are perhaps a bit more scholarly than most. In fact, they are especially knowledgeable about the biology of that notorious two-legged species, *Homo sapiens*. They have been brought together to document their relationship with humans over the last several millennia. Pause for a few moments and consider what they might say . . .

Perhaps the wolves' discussion would chronicle the evils of the human species, including details of atrocities committed against lupine ancestors down through the centuries. They might discuss the bizarre workings of the human imagination and the hopeless confusion of fact and fiction about wolf relationships with humans. The discussion might also express admiration for the way early humans respected wolves and imitated their living in family bands, maintaining pair bonds for years at a time, communicating in complex ways, and hunting cooperatively. The effects of advances in human technology might be detailed. The recent and long-awaited legal protection for wolves and the soaring popularity of wolves among some humans would certainly deserve mention. After an exhaustive review of the wolf-human relationship, the wolves might finally conclude that it has taken so many forms, depending on time and place, that generalizations are impossible.

We begin this chapter with the incredibly broad range of relationships between wolves and humans in mind. Our focus will be on the following topics: past and current human perceptions of wolves, wolf behavior toward humans, depredations on domestic animals, and

the economic impacts of wolves, especially their predation on big game animals of importance to hunters.

Human Attitudes toward Wolves

Wolves have been of special interest to many human cultures around the Northern Hemisphere from prehistoric times to the present. Attitudes toward the animal range from reverence to hatred. Neither the historical record of humanity nor of wolves (if wolves could write one) would be complete without something being said about the other species.

Humans often determine where wolves can exist and influence their ecology and behavior in various ways (Young and Goldman 1944; Mech 1970; Boitani 1995; Stephenson et al. 1995; Thiel and Ream 1995; Hayes and Gunson 1995; Bangs and Fritts 1996). The wolf's range has waxed and waned during the past 2,000 years as humans alternately turned up and then turned down the heat of persecution (Okarma 1993). Humans are a major cause of wolf mortality in much of the wolf's current range. We tend to think of wolves as creatures of wilderness (Theberge 1975), yet they often exploit niches in which they are intimately intertwined with human communities (Thiel et al. 1998). In Romania, some travel city streets at night in search of food (Promberger et al. 1997). In Italy, some depend on village garbage dumps for food (Boitani 1982).

Many aspects of the wolf-human relationship are based on sometimes irrational cultural perceptions. Persecution of the wolf has often been out of proportion to the threat it actually posed to people. Consider the

destruction of Scotland's forests to rid the country of the last wolf (Boitani 1995), the relentless pursuit of the last wolves in the American West during the 1920s and 1930s (Young and Goldman 1944; Young 1970; Lopez 1978; Brown 1983; McIntyre 1995; Hampton 1997), and the continuing fear among some people of wolf attacks despite the overwhelming odds against such attacks (Kellert 1999).

Similarly, public reaction to contemporary wolf management programs is often extreme, as occurred when Alaska proposed wolf control in a small part of that state's vast area (Stephenson et al. 1995). These diverse reactions are fairly typical of the historical relationship between human cultures and wolves.

The negative image of the wolf in the psyche of many people may be deeply ingrained, and not only because of the last ten to twenty centuries of history. In advancing his proposal for the coevolution of a gene-culture system, Wilson (1984, 1993) pointed to the almost universal human fear of snakes and suggested it is related to genetically prepared learning and retention of negative experiences. Ulrich (1993) provided convincing evidence that humans are biologically prepared to acquire and retain adaptive biophobic responses to certain natural situations and stimuli that contained some kind of risk in former times.

Predators probably posed an important risk to humans for much of our history, and wolves, though not as widespread as snakes, have flanked the development of culture from the time early humans colonized Eurasia. Conservation efforts around the world must contend with these long-standing fears. Negative perceptions of the wolf make it difficult to find a compromise between human interests and wolf conservation. Additional concern about wolves comes from the negative effects wolf predation can have on livestock producers, rural communities, and local economies, as discussed below.

Ultimately, the wolf exists in the eye of the beholder. There is the wolf as science can describe it, but there is also the wolf that is a product of the human mind, a cultural construct—sometimes called the “symbolic wolf”—colored by our individual, cultural, or social conditioning (Lawrence 1993). This wolf is the sum total of what we believe about the animal, what we think it represents, and what we want and need it to be. To many humans, this animal is the ultimate symbol of wilderness and environmental completeness. To others—for example, a Wyoming rancher or an Italian shepherd—it represents nature out of control, a world in which the

rights and needs of rural people are subjugated by city-dwelling animal lovers intent on imposing their conservation values on others.

The symbolic status of the wolf, or shall we say “wolf mythology,” is so strong that biological facts about the animal are often irrelevant—a situation especially vexing to biologists (Mech 2000b,c). For example, when biologists brief public officials about the actual numbers of livestock that wolves kill, the officials often focus instead on their constituents' perception of the problem and perhaps on their own prospects for re-election, not facts and figures about wolf depredations.

What people *choose* to believe about wolves can be more important than the objective truth, or at least those beliefs can have a greater effect. Whether looking at the past, the present, or the future, it is beliefs and perceptions that primarily affect the survival of wolves. For example, the battle of wills that happened over restoration of the wolf to Yellowstone National Park and central Idaho had more to do with what wolves symbolize than with the animal itself (Fritts et al. 1995).

Why does the wolf arouse diverse passions in humans that are not kindled to the same degree by most other animals, such as the bears and the large cats? How do we explain the pervasiveness of the wolf in folklore, and why have we relentlessly exterminated wolf populations in the past? And what might the recent popularity of wolf-dog hybrids as pets tell us about humans and wolves? Why, as we enter the twenty-first century, does wolf recovery and management attract such strong public interest (Mech 2000b)? The answers to these questions are elusive and complex, but might tell us much about our own species. We hope that the following discussion will provide some insight into our relationship with wolves.

Early Humans

Ethnographic accounts from early historic times, as well as evidence from archaeological sites, provide clues about attitudes toward wolves among prehistoric peoples. Cave paintings and associated artifacts in France show that humans have had a close relationship with animals for at least 100,000 years (Pfeiffer 1982). Rituals, ceremony, and art associated with animals increased about 30,000 years ago, at the beginning of the Upper Paleolithic period. This development is thought to represent an effort by early hunters to increase their likelihood of success.

A complex spiritual relationship apparently existed

between early hunters and the prey on which they depended for food and clothing. Like many more recent societies, Upper Paleolithic people may have believed in “a master of the hunt or keeper of the animals, an exalted being that provided game, established rules for the chase and punishments if the rules were broken, and who had to be obeyed and appeased when angry” (Pfeifer 1982).

Early humans and wolves occupied similar ecological niches. Both were broadly adapted predators of large herbivores and hunted in family groups (Schaller and Lowther 1969; Mech 1970; Peters and Mech 1975a; Hall and Sharp 1978). People and wolves lived in loosely analogous societies that shared such characteristics as pair bonding, staying together year-round (not just for a breeding season), extended family clans, group cooperation, communal care and training of young by both males and females, group ceremonies, leadership hierarchies, and the sharing of food with kin. Like early humans, wolves often defended their hunting territory from other packs (see Mech and Boitani, chap. 1 in this volume). Although wolves and humans probably scavenged from each other’s kills, we do not know whether Paleolithic people saw wolves as competitors.

Some authors suggest that wolves may be models for understanding early humans (Hultkrantz 1965; Schaller and Lowther 1969; Hall and Sharp 1978). We can be sure that early people observed wolves at length on the open plains, steppes (Kumar and Rahmani 2001), and tundra (Mech 1998a) and came to be familiar with their behavior and some of its similarities to their own (Stephenson and Ahgook 1975; Stephenson 1982). This sort of relationship between humans and wolves as fellow predators persisted in North America longer than in Europe because of the later transition from hunting to predominantly agricultural economies.

Native Americans

Most of North America’s indigenous people were familiar with wolves and often regarded them as spiritually powerful and intelligent animals. Wolves were “medicine” animals and were sometimes identified with a particular individual, tribe, or clan (Lopez 1978). Some tribes believed that wearing the skin of the wolf brought about a supernatural union of human and wolf (fig. 12.1). Unlike elements of contemporary society, however, native cultures did not elevate wolves above other animals. Wolves were hunted and trapped by many Native Amer-



FIGURE 12.1. Many indigenous peoples in North America regarded wolves as spiritually powerful animals, and some used their pelts to symbolize a wolf-human relationship.

ican tribes, often with rituals and apologies to the spirit of wolves, but rarely with rancor or guilt.

The Nunamiut Inupiat in Alaska’s central Brooks Range have had a long association with wolves. Like many other Eskimo peoples, they relied historically on wolves and other furbearers as an important part of their economy (E. S. Hall 1981). Furs provided clothing and were traded with other natives and later with Europeans. During the 1970s, not long after the Nunamiut had settled in their village of Anaktuvuk Pass after centuries of semi-nomadic life, R. O. Stephenson was able to work with them as an apprentice. He gained an understanding of their view of wolves, which may be indicative of those of other North American hunting societies (Stephenson and Ahgook 1975). Through their long experience observing and hunting wolves in the open foothills and

mountain valleys of the Brooks Range, the Nunamiut acquired a refined understanding of wolves. They regard wolves as very smart animals and skilled hunters, possessing keen senses.

Like other northern peoples who hunted and trapped wolves, the Nunamiut often howled to call wolves, stalked sleeping wolves, or used deadfalls, traps, and snares to capture them (Boas 1888; Stephenson 1982; Nelson 1983; Mary-Rousseliere 1984). Hunters often expressed appreciation for the wolf's abilities and social complexity. They never spoke harshly about wolves, bragged about their ability to capture wolves, or announced their intention to hunt them. To do so could offend wolves or other animals and bring bad luck. The wolf did not evoke fear, although the Nunamiut were less sanguine than is our society about the possibility of attacks on people. This caution stemmed from a few attacks on people by hungry wolves prior to the advent of firearms and several incidents involving rabid wolves.

Relations between wolves and North American Indians were in many respects similar to those between wolves and Eskimos. Most tribes took precautions to avoid offending wolves and engendering bad luck or other consequences. However, historic accounts suggest considerable diversity in attitudes. In Alaska, the Tanaina people believed that wolves were once men (Osgood 1936) and viewed wolves as brothers. It was said that if a man was hungry and lost, he need only ask his brother the wolf for help (Townsend 1981). In contrast, the wolf was generally feared by the Chilicotin of British Columbia, and contact with the animal was thought to cause nervous illness and possibly death (Lane 1981).

Among Indians of the U.S. western plains, the wolf personified craft in war. Scouts often wore wolf skins, and the sign for "scout" and for "wolf" was the same in sign language. It was believed that wolves sometimes talked to people and warned them of the presence of enemies. Boys were told to imitate the wolf's habit of pausing to look back at its trail, even when running for its life, and to acquire its ability to endure severe conditions (Mails 1995).

Ethnographic studies do not suggest that there was widespread concern among Native Americans about the effect of wolf predation on important game populations. However, the oral history of several northern Athabascan groups includes descriptions of efforts to reduce wolf predation by killing pups at dens (Peter John, First Traditional Chief, Tanaina Chiefs Region,

AK; Tom Denny, Tanaina Village, AK; Ron Chambers, Champagne-Aishihik First Nation, Yukon, Canada; and Nick Bobbie, Tanaina Athabascan, AK, personal communications). Those efforts may have been prompted by the often limited and unpredictable supply of game typical of the northern interior of the continent (Burch 1972).

Eurasians

In Eurasian cultures, the socioeconomic relationship between early human societies and their environment largely determined their perception of the wolf. During much of history, economies were based on hunting and making war. Nomadic and sedentary shepherding came later, followed by crop and farm animal production (Boitani 1995). Like Native Americans, the early Eurasian cultures admired the wolf and, in some ways, tried to emulate it. However, societies that made their living as nomadic shepherds were vulnerable to wolf depredations and came to hate the animal (Boitani 1995).

The wolf appears in the earliest stories about European gods and was credited with involvement in human ancestry (Boitani 1995). Early Germanic warriors regarded the wolf as a totem. Anglo-Saxon nobles and kings, like American Indians, named themselves after wolves, attempting to associate themselves with admirable characteristics of the animal. According to Romanian biologist O. Ionescu (personal communication), ancient inhabitants of what is now his country portrayed the wolf on their battle flag.

The wolf was also viewed positively in the mythology of the Celts and the Greeks (Boitani 1995). Apollo, the god of light and order, was associated with the wolf in a predominantly positive way. Building on an earlier Greek legend, a well-known story describes the founding of Rome by the twins Romulus and Remus, who were raised by a nurturing female wolf. The Sabines regarded the wolf as a totem animal and had religious practices that centered around it. The positive view of the wolf among the Greeks and Romans survived for several centuries despite an influx of negative attitudes from northern Europe. The resulting ambivalent attitude in parts of Europe, especially the Mediterranean area, helped prevent the complete extermination of the wolf on that continent (see Boitani, chap. 13 in this volume).

The changes in Western thought about the environ-

ment and the wolf that were brought about by Christianity were second in importance only to those accompanying the domestication of animals. They were felt first in Europe (Ortalli 1973; Boitani 1995) as man switched from considering himself part of the natural world to master of it. The Bible does not seem to judge animals as “good” or “bad.” All were created by God and declared “good” by God in the beginning (Genesis 1:25), and God intentionally saved all “kinds” during the great flood (Genesis 6:19–20). The wolf is mentioned in the Old and New Testament only as a *symbol* of rapacity, wantonness, cunning, and deceit, in reference to human characteristics. Nonetheless, the animal itself came to be viewed as evil, symbolizing threats to the Roman Catholic Church (Boitani 1995). During the early Middle Ages the wolf was viewed as evil and was a major character in the legends of the saints (Ortalli 1973). For over a thousand years books influenced primarily by the Catholic Church, such as the *Physiologi*, presented animals, including wolves, in highly fanciful ways by way of teaching moral lessons.

Science and natural history writings before the mid-twentieth century typically portrayed the wolf in a negative light. In the early nineteenth century, one could turn to *The Natural History of Quadrupeds* and read:

Wolves are such ferocious and useless creatures that all other animals detest them, yea they even hate each other, and therefore scarcely ever live together, each one in its own separate hole. . . . Perhaps of all other animals, wolves are the most hateful while living and the most useless when dead. . . . The continual agitations of this restless animal renders him so furious, that he frequently ends his life in madness. (Robinson 1828)

Danger from wolves was a common theme in early literature and folklore. European and Russian literature abounded with fables, legends, references to werewolves, and tales about children raised by wolves. Werewolves were feared even more than real wolves because they added the supernatural power of the devil to the strength, ferocity, and cunning attributed to wolves (Lopez 1978; Stekert 1986; Fogleman 1988; Slupecki 1987). Folk tales such as “Little Red Riding Hood” and “The Three Little Pigs” taught carefulness and a work ethic. Though intended to be symbolic or metaphorical, they had a profound effect on how wolves were viewed in Western culture (Levin 1986; Greenleaf 1989). The nega-

tive view was so persuasive that it was not until the mid-twentieth century that Western culture considered the wolf worthy of scientific inquiry (see Boitani, chap. 13 in this volume).

In Japan, the relationship between religion and wolf conservation was quite different. The Japanese word for wolf, *ookami*, translates as “great god.” During the era of the Shoguns (710–1867 A.D.), damage to agricultural crops by deer and other wildlife was a common problem. Farmers regarded wolves as beneficial because they killed wildlife that damaged crops. In the 1600s, people prayed to wolves at shrines throughout Japan, asking them to kill the crop-eating wildlife. One shrine reportedly bred wolves and rented them to villagers to combat wildlife pests (N. Maruyama, Tokyo Noko University, personal communication). This era ended in 1868 when the Shoguns lost power and Western advisors were brought to Japan to modernize agriculture (McIntyre 1996; N. Maruyama, Tokyo Noko University, personal communication). The Japanese were advised to poison their wolves, thus ending their reverence and tolerance for the animal. That farmers and ranchers in different parts of the world were simultaneously praying to wolves and finding new ways to kill them attests to the diversity in wolf-human relations.

Post-settlement Americans

European colonists brought to America a fear and hatred of the wolf based largely on Old World myth and folklore. Attitudes were strongly negative even in the earliest settlements (Young and Goldman 1944; Young 1970; Nash 1967; Lopez 1978; Fogleman 1988; McIntyre 1995; Hampton 1997). There were rational reasons to impugn the wolf, as its depredations on livestock posed a real threat to early settlements (see references in Fogleman 1988 and McIntyre 1995). The wolf ultimately became a metaphor for the environmental challenges the new North Americans had to contend with and felt a moral obligation to subdue. The goals of subjugating wolves and wilderness became synonymous.

This decidedly negative view of wolves prevailed during their eradication from most of the United States and large portions of Canada. The fervor with which European settlers and pioneers killed wolves (Young 1944; Lopez 1978; Brown 1983; Fogleman 1988; Thiel 1993; McIntyre 1995) far exceeded the intensity of persecution in Europe, where campaigns were more localized and

short-lived (see Boitani, chap. 13 in this volume). Hampton (1997) called it “the longest, most relentless, and most ruthless persecution one species has waged against another.”

Native ungulate populations were decimated by settlers and market hunters during the late 1800s, and large numbers of sheep and cattle were introduced into open range in the American West. Wolves and other large predators turned increasingly to livestock to survive, and the human determination to kill these carnivores increased.

The fate of the wolf in the American West was sealed when Congress established the federal Bureau of Biological Survey and its Division of Predator and Rodent Control (PARC) in 1915, with the mission of eliminating wolves and other large predators from all federal lands (Dunlap 1988). The threat to livestock became the strongest argument for killing every last wolf at taxpayer expense, even in areas remote from livestock range (Young and Goldman 1944; Curnow 1969; Weaver 1978; Lopez 1978; Brown 1983; McIntyre 1995; Hampton 1997).

During 1890–1930, the perception of the wolf by the U.S. public and Congress was strongly influenced by accounts of outlaw wolves that allegedly killed stock in large numbers. Many of these accounts were embellished and were developed, at least in part, by members of the U.S. Biological Survey to generate and maintain funding for their programs (Gipson et al. 1998). However, they continue to influence the perception of wolves among ranchers. Kellert et al. (1996) suggested that wolf destruction in the United States and Canada reflected an urge to rid the world of an unwanted and feared element of nature, including, perhaps, the possibility that settlers might succumb to the attractions of wildness and the absence of civilization.

Prior to the mid-twentieth century, most American biologists denigrated the wolf (Dunlap 1988). E. A. Goldman defended PARC and its poisoning at the 1924 meeting of the American Society of Mammalogists: “Large predatory mammals, destructive to livestock and game, no longer have a place in our advancing civilization” (Dunlap 1988, 51). However, when PARC nearly exterminated wolves in the American West, several biologists in the American Society of Mammalogists did object.

Aldo Leopold (1949) was one of the first Americans to speak in defense of the wolf. In his essay “Thinking like a Mountain,” he related how the experience of killing a wolf and watching the “fierce green light” fade from her

eyes helped change his opinion on the need to eradicate wolves, although he continued to push for wolf bounties (Flader 1974).

Contemporary Views

In the early 1940s, Leopold (1944) proposed restoring wolves to Yellowstone National Park, where they had been eradicated by the government only a decade earlier (Jones 2002). The first detailed field studies of wolves were launched in North America in the late 1930s (Olson 1938; Murie 1944) and 1940s (Cowan 1947; Stenlund 1955). By the 1960s, researchers such as Durward Allen, Douglas Pimlott, David Mech, and others were presenting more objective and balanced information about wolves and arguing for their conservation.

The prevailing attitude toward the wolf in Europe remained negative long after the animal was exterminated from most of the continent. This was true even in countries where no wolves remained. The Mediterranean countries, where an ambivalent attitude persisted, were an exception (Boitani 1995). The first wolf conservation programs in Italy and Spain began during the 1970s. Able European spokespersons emerged, including Erkki Pulliainen (Finland), Dimitry Bibikov (USSR), Anders Bjärvall (Sweden), Luigi Boitani (Italy), Eric Zimen (Germany), and others. However, negative attitudes toward wolves have generally persisted in eastern Europe and in the former Soviet Union.

The book *Never Cry Wolf* (Mowat 1963), a mostly fictional work (Banfield 1964; Pimlott 1966; Mech 1970; Goddard 1996), was the first positive presentation of wolves in the popular literature, with over a million copies sold. Despite its depiction of fiction as fact, this widely read book probably played a greater role than any other in creating support for wolves. A Disney movie based on the book reached millions of Americans and Canadians. Other early books that touched the public and biologists alike were *The Wolves of Mount McKinley* (Murie 1944), *Arctic Wild* (Crisler 1958), *The Custer Wolf* (Caras 1966), *The World of the Wolf* (Rutter and Pimlott 1968), and *The Wolf: The Ecology and Behavior of an Endangered Species* (Mech 1970), still in print with over 100,000 copies in circulation. In 1978, Barry Lopez’s *Of Wolves and Men* provided a lucid and poignant exploration of the human relationship with wolves during recorded history, including the following provocative observation:

Throughout history man has externalized his bestial nature, finding a scapegoat upon which he could heap his sins and whose sacrificial death would be his atonement. He has put his sins of greed, lust, and deception on the wolf and put the wolf to death—in literature, in folklore, and in real life.” (Lopez 1978, 226)

Increasingly favorable attitudes toward the wolf reflected a general change in outlook on wildlife and the environment. Legal protection of game animals was finally extended to various predators, and bounties were gradually eliminated (Dunlap 1988; Keiter and Holscher 1990). Objections to the extensive government wolf control programs in Alaska and Canada were raised (Theberge 1973). By the late 1960s, there were more calls to restore wolves to Yellowstone National Park (Mech 1991a).

During the 1970s, organizations with the sole mission of wolf conservation were formed. Key among them was the Wolf Specialist Group (Pimlott 1975; Mech 1982b) of the International Union for the Conservation of Nature and Natural Resources (IUCN), recently renamed the World Conservation Union. In 1973, D. H. Pimlott formed the Wolf Specialist Group at a meeting in Stockholm. The group then developed a “Manifesto on Wolf Conservation” (Pimlott 1975) as a guide for countries wishing to recover and conserve wolves, and this manifesto has been updated twice and approved by the IUCN. Globally, IUCN (2000) classified the wolf in its “Vulnerable” category in 2000.

Mainstream public conservation organizations in the United States such as the National Wildlife Federation, Audubon Society, and Defenders of Wildlife also became involved in wolf conservation (Tilt et al. 1987), as did the World Wildlife Fund in both the United States and Eurasia. In 1974, wolves were classified under the Endangered Species Act of 1973 as “endangered” in the contiguous United States. That action triggered an intense debate over whether U.S. wolves actually needed legal protection (Van Ballenberghe 1974; Llewellyn 1978; Thiel 1993).

As concern about human effects on the natural world increased, much of the public feared that wolves would soon be extinct. This fear was fostered by the failure of the U.S. government’s Endangered Species List to distinguish between species that were endangered globally, such as the California condor and Kirtland’s warbler, and those that were endangered only locally (Mech 2000c). In truth, tens of thousands of wolves survived in

Canada and Alaska and hundreds in Minnesota, and the former Soviet Union supported 50,000 (Bibikov 1975). A small management program in the Yukon in the early 1980s (involving 2% of the Yukon wolf population) was incorrectly reported in Germany as an indiscriminate program to kill 5,000 wolves and to protect people from attacks (R. D. Hayes, personal observation). Across the United States, privately owned colonies of captive wolves were established with the expectation that those wolves would be used to reestablish the species in the wild (Mech 1995a). Several people appointed themselves “wolf educators,” propaganda and inaccurate information were disseminated (Blanco 1998; Mech 2000b), and opposition to any form of wolf control broadened.

Numerous studies of human attitudes toward wolves in the United States in recent decades have documented strong public support for wolves (Kellert 1986, 1991; McNaught 1985; Lenihan 1987; Biggs 1988; Tucker and Pletscher 1989; Bath and Phillips 1990; Johnson 1990; Bath 1991a,b; Thompson and Gasson 1991; Duda and Young 1995; Bright and Manfredo 1996; Kellert et al. 1996; Pate et al. 1996; Wilson 1999). Most have focused on areas in the Upper Midwest where wolves were present and on western states where reintroduction was being planned or discussed. Residents of western states predominantly favored wolves and preferred they be restored. Studies of attitudes toward red wolves and their restoration have revealed even stronger regional support (Quintal 1995; Mangun et al. 1996; Rosen 1997). Except for Alaskans, who are generally positive and knowledgeable about wolves, residents living close to wolves are less positive about them than those living farther from wolf habitat (Williams et al. 2002).

Farmers and ranchers hold the most negative view of wolves in the United States, and probably elsewhere, with surveys showing up to 90% disapproval (Buys 1975; Kellert 1985, 1986; Nelson and Franson 1988; Bath and Buchanan 1989). This is true regardless of whether the farmers live close to a wolf population or have had any experience with wolves. However, Minnesota farmers regarded wolves far more positively in 1998 than in 1985 (Kellert 1999). The most positive and protectionist views of wolves are held by urban people and members of environmental organizations (Kellert 1987, 1999; Quintal 1995; Bath and Buchanan 1989; Duda et al. 1998). In general, more negative views are found among older, less educated, and lower-income people (Kellert 1996).

Most Americans, however, know little about wolves.

Some studies indicate that greater knowledge of wolves is related to a more positive attitude about them. However, many urbanites with little knowledge of wolves are highly positive about the animals (Kellert 1999).

The origins of current American attitudes about wolves are complex and are linked to the symbolic and economic value of wolves. People favorable toward wolves and their restoration often cite values related to ecosystem completeness, the right of the wolf to exist, and recreational value. Reasons for disliking wolves or opposing wolf restoration include the expectation of attacks on livestock, pets, and humans; cost; declines in big game populations; loss of self-determination; erosion of private property rights; and fear of more restrictions on the private use of federal land (Bright and Manfredi 1996; Wilson 1997; Scarce 1998).

In the western United States, wolf restoration is inextricably linked to a long-standing debate over how federal land is used—an issue that often pits local and regional views against national perspectives. Government is widely distrusted, perhaps especially by rural people. There are fundamental differences in the way urban and rural people in the West view nature (Wicker 1996). Various surveys show that although most Americans value wolves, they do not do so to the exclusion of important human needs (Kellert 1986, 1987, 1999; Tucker and Pletscher 1989; Thompson and Gasson 1991; Wolstenholme 1996).

Attitudes toward wolves in Canada are similar to those in the United States (Murray 1975). In British Columbia, viewpoints vary on wolf management and control and on the effects of wolves on the livestock and ungulate populations (Hoffos 1987). Attitudes toward wolves and wolf restoration in New Brunswick are strongly influenced by anticipated effects on deer hunting and are related to gender (females are more favorable to restoration), education level, knowledge of wolves, size of community, level of fear of wolves, and big game hunting experience (Lohr et al. 1996). Similar factors determined the willingness of Manitoban residents to maintain wolves in Riding Mountain National Park (Kellert et al. 1996; Ponech 1997).

The views of contemporary Native Americans toward wolves appear to vary depending on how “traditional” a person is (Vest 1988; Segal 1994). The reintroduction of wolves to Idaho was of great significance to the Nez Percé tribe, restoring pride and spiritual power and providing an opportunity for economic revitalization (Robbins 1997). However, in the southwestern United States,

Apaches attribute no special significance to the wolf and opposed its reintroduction (D. Parsons, USFWS, personal communication). Young Native Americans are often concerned that the return of the wolf would upset or restrict their modern lifestyle. Younger and middle-aged Kalispell Indians in Washington were more likely than older individuals to fear wolves (Segal 1994). First Nations in Canada and Alaska often have polarized views of wolves, which depend on the status of wildlife around their communities (R. D. Hayes, personal observation); attitudes toward wolves reflect a balance between their sometimes negative economic impacts on other wildlife uses and their cultural and spiritual importance to First Nations societies (Chambers 1995). Some First Nations in Alaska and Canada are involved in developing wolf control programs to help maintain ungulate numbers (Dekker 1994; Hayes and Gunson 1995).

Modern European attitudes about wolves have generally improved during the past two decades, especially in urban areas. Resentment toward the wolf is still strong in many rural areas (Promberger and Schröder 1993). The only attitude study in Italy, carried out in 1975–1976 in the Abruzzo region, revealed that fears and prejudices were strongly correlated with ignorance about the wolf (Serracchiani 1976). Attitudes have gradually improved in Finland (Pulliainen 1993). In Sweden and Norway, most people, even in rural areas, want the wolf to survive (Andersson et al. 1977; Bjärvall 1983; Bjerke et al. 1998). However, over 70% of reindeer owners and farmers in Sweden are against protective measures (Andersson et al. 1977).

In Scotland, 44% of the general public and 58% of local people are against wolf reintroduction to the Highlands; 17% of local residents and 36% of the general public are in favor (D. MacMillan, Macaulay Land Use Research Institute, personal communication). Fifty-three percent of Spanish gamekeepers say wolves should be eradicated, and 38% favor some control in areas adjacent to their operations (Blanco et al. 1992). In several European countries, rural law enforcement personnel often sympathize with poachers and fail to arrest and prosecute those who illegally kill wolves (Francisci and Guberti 1993; Boitani and Ciucci 1993). A recent expansion in European wolf range (Promberger and Schröder 1993) is partly the result of greater tolerance, but protective laws probably have played a more important role.

Attitudes about wolves in Croatia have also improved recently, corresponding to a decline in both wolf numbers and the number of livestock killed (Gyorgy 1984;

Huber, Berislav et al. 1993; Huber, Mitevski, and Kuhar 1993). The treatment of the wolf in Croatia changed from persecution to protection during the height of the Serb and Muslim war; 1994 was declared the “Year of the Wolf” and a commemorative stamp was issued (Gibson 1996). However, respondents in a small survey in Macedonia in 1992 unanimously favored maintaining the bounty for killing wolves (Huber, Mitevski, and Kuhar 1993). A belief in werewolves lingers in some Slavic countries, as well as in Poland and Bulgaria (S. Tolstoy, Russian Academy of Science Institute of Slavic Studies, personal communication; Slupecki 1987; Tolstoy 1995).

The potential for natural or human-assisted recovery of the wolf in Asia is limited. Though studies of attitudes are lacking, the prevailing view of the wolf is negative throughout most of Asia (Shahi 1983; Bibikov 1988; Fox and Chundawat 1995). A 1987–1988 study in Kazakhstan, where 60,000–62,000 wolves remain, indicated that 59% of people preferred elimination of the wolf using any method; only 3% favored protection (Stepanov and Pole, presentation at the 1994 Large Carnivore Conference in Bieszczady, Poland). Surveys in 1993 and 1996 in Japan revealed only moderate interest in wolves and their possible restoration (Koganezawa et al. 1996).

Perspectives of Biologists

Because wolves and wolf management are so controversial, wolf biologists face a variety of challenges in different parts of the world. In some countries, biologists may be among the few people working toward conservation of this predator (Zimen and Boitani 1979). In Western countries, they usually function in a complex environment in which supporters of wolves are many, but so are their views and demands (Mech 1995a, 2000b). Wolf managers must find a balance between idealism and pragmatism and between their focus on populations and animal rights activists’ emphasis on individual animals. North American wolf biologists often disagree about the extent to which wolves regulate prey populations and about the need for, and effects of, wolf control (see Mech and Peterson, chap. 5, and Boitani, chap. 13 in this volume).

Strong public interest and the clash of human values often result in unusual demands on biologists who work with wolves (Bass 1992; Bangs 1995; Steinhart 1995; McNamee 1997). The bureaucratic working environment can be complex. For example, the wolf recovery program in the northwestern United States involved five

federal agencies, three state wildlife departments, at least seven Native American groups, and land management agencies in at least four levels of government (Fritts et al. 1995). Whether researchers or managers, biologists often find themselves in the media spotlight and in the midst of controversy. Criticism from anti-wolf groups has been common historically, but criticism from pro-wolf organizations has intensified recently (Mech 1995a, 2000b; Blanco 1998).

Educating the Public about Wolves

Worldwide professional efforts to educate the public about wolves began in the early 1970s. The IUCN Manifesto on Wolf Conservation (Pimlott 1975) and all four U.S. Wolf Recovery Plans recommended public education to promote wolf conservation. Volunteers and conservation organizations took up the challenge of combating the wolf’s negative image in both North America and Eurasia with varying degrees of accuracy and effectiveness (Mech 2000b). Prior to the reintroduction of wolves to Yellowstone, project biologists spent about 60% of their time on some form of public outreach (Fritts et al. 1995). Similarly, in all areas of Europe where wolves remained by 1970, wolf biologists promoted and conducted public education about wolves.

Although an informed public is essential to wolf conservation, defining what public education should consist of is problematic. There are important and critical differences between objective wolf education and wolf advocacy or activism. An unbiased portrayal of wolf and wolf management issues may not be possible, in part because ethical and other subjective values are involved (Gilbert 1995). If not carefully tempered, wolf “education” can reflect personal values (Haber 1996). Most wolf biologists believe that an objective portrayal of the wolf is needed to sustain wolf recovery. This means that the conflicts caused by wolves must be fairly expressed along with the solutions and compromises necessary to resolve those conflicts (Fritts et al. 1995; Mech 1995a,e; Blanco 1998).

Many different approaches have been used to inform and educate the public about wolves: one-on-one visits with key landowners and opinion leaders, wolf education kits in schools, wolf howling excursions, traveling and permanent wolf exhibits, public lectures, and tame “ambassador” wolves.

Dozens of nonfiction books and magazines about wolves are now available for all ages and levels of biological expertise. In 1990, the International Wolf Center

(IWC) launched *International Wolf* magazine, which includes wolf conservation news from around the world. Technical literature about wolves proliferated in the 1980s and 1990s. One of at least four wolf bibliographies contains 420 pages (Mech 1995e). Numerous Internet sites offer information (and misinformation) on wolves. For example, the International Wolf Center's home page receives over a million hits and 60,000 unique visits per month (V. Du Vernet, IWC, personal communication).

Wolves and the News Media

Television and newspapers are the public's primary sources of information about wolves. Several accurate and well-balanced documentaries about wolves and wolf recovery have been produced. However, news media are attracted to controversy, and wolf recovery, depredations, control programs, and most any other wolf-related topics seem irresistible. The Yellowstone wolf reintroduction was intensively covered by sixty international media. Popular information about wolves is often biased or inaccurate (Blanco 1998; Mech 2000b). When wolf stories appear, the extreme views of opponents and supporters of wolves are often highlighted, further polarizing the issue. The way the media covers wolves leaves the impression that they are more of a problem than other animals (Bangs and Fritts 1996).

Wolf-Related Organizations

About forty nongovernmental organizations (NGOs) in North America and at least a dozen in Europe exist to promote wolf conservation (M. Ortiz, IWC, personal communication; J. Warzinik, Timber Wolf Information Network, personal communication). Reintroduction of wolves to Yellowstone and Idaho might not have happened without the Wolf Fund, Defenders of Wildlife, the Wolf Education and Research Center, the National Wildlife Federation, and other organizations that continually lobbied both the U.S. Congress and federal agencies (Fischer 1995).

In addition to advocating for wolf recovery, a few NGOs, including Defenders of Wildlife in the northern Rockies and southwestern United States (Fischer 1989) and the World Wildlife Fund in Italy, have even sponsored livestock depredation compensation funds to assist wolf recovery. Private foundations and public contributions augmented government funding for the recovery program in Yellowstone and the red wolf program in the eastern United States. Conservation organizations have also furthered wolf conservation by holding

numerous meetings worldwide that bring together biologists, managers, educators, and the public. For example, the International Wolf Center sponsored international wolf symposia in 1990, 1995, and 2000, and plans to continue this endeavor.

Various factors motivate pro-wolf organizations (Boitani 1995), and these groups often differ in approach. Some pro-wolf groups appear to be most concerned with the ethics of wolf management. In 1996, a group called "Friends of the Wolf" opposed the capture of wolves in British Columbia for reintroduction into the United States, offering a \$5,000 reward for release of captured wolves. The Sierra Club attempted to prevent reintroduction of wolves into Idaho as an "experimental/nonessential" population (see Boitani, chap. 13 in this volume), preferring that colonization happen naturally.

Although most wolf-related groups are pro-wolf, some are anti-wolf. When wolves from Italy recolonized France's southern Alps in 1992, local shepherds joined with hunters for the first time in Europe to form a league for wolf eradication. In the United States, organized opposition to wolf restoration emerged during the 1990s. Preventing wolf reintroduction in the U.S. northern Rockies was the objective of the No Wolf Option Committee, the Abundant Wildlife Society, and the American Farm Bureau's Wyoming chapter. The "Wise Use" movement also opposed wolf recovery based on anticipated restrictions on use of public land and other resources by local residents. Some people suspect that wolf recovery is part of a conspiracy by the government and environmentalists to prohibit grazing, mineral extraction, and recreational use of public land (Fischer 1995; Wicker 1996).

Economic Value of the Wolf

Wolves have intangible values to many people, such as the important role some think they play in an ecosystem (but cf. Mech 1996) and the enrichment of nature (Pimlott 1975; Kellert and Wilson 1993). But wolves also have a complex economic value, which is hard to measure and overlain with emotional issues. In the past, the wolf was believed by most of society to have a mainly negative economic impact because it killed livestock and game animals. Economic benefit came to the few who sold furs or collected some form of payment for killing wolves (Thiel 1993), and economic loss was one of the most common arguments for wolf eradication.

Untold amounts of private and public money were spent to eradicate or control wolves (Dunlap 1988; Thiel

1993; McIntyre 1995; Hampton 1997). By one estimate, over three centuries of wolf bounties in North America cost governments, stock associations, and private individuals about \$100 million (Hampton 1997, 136). During the Soviet period (1917–1991), Russia spent over \$300 million on wolf bounties, stock insurance, and other payments related to wolf damage (D. I. Bibikov, interview by *Russian Conservation News*, Managing Editor Anya Menner, reprinted in *Natural Area News* 1[2]:5–7).

Economics is often brought into arguments about the desirability of wolf recovery and conservation. The cost of wolf recovery in the U.S. northern Rockies was projected to be \$12 million over a 30-year period. Although this is only 5 cents for each American citizen (Bangs and Fritts 1996), cost was the main reason people gave for opposition.

The annual regional economic losses from the Yellowstone and Idaho wolf reintroductions were predicted to be \$187,000–\$465,000 in lost hunter benefits, \$207,000–\$414,000 in potential reduced hunter expenditures, and \$1,888–\$30,470 in livestock losses. However, the yearly gain would be \$23 million per year in increased tourist expenditures (Duffield 1992; USFWS 1994b; Bangs and Fritts 1996).

Wolf management often requires substantial resources (Archibald et al. 1991; Mech 1998b). Wolf control to enhance deer hunting on Vancouver Island produced \$5.90 of resident deer hunter benefits for every dollar spent (Reid and Janz 1995). Wolf reductions in interior Alaska and southern Yukon cost \$500–\$1,500 per wolf, but returns were high in terms of additional ungulate harvest (Boertje et al. 1995). The least expensive management methods (poisoning and aerial shooting by the public) are currently the least acceptable to the public (Fritts 1993; Boertje et al. 1995; Cluff and Murray 1995).

Tourism associated with wolves has recently emerged as a significant economic benefit. Wolf-related tourism helps fund wolf research in Poland and Romania (C. Promberger, personal communication). Such opportunities are limited by the elusive habits of the wolf, terrain, the need for a well-developed tourism infrastructure (technology, guides, accessibility), and cost (Wilson and Heberlein 1996). Opportunities to see wolves without professional assistance are rare and limited to some areas of open terrain (Mech 1995b). For example, from 1995 through 2000, some 70,000 visitors observed wolves in a nonforested part of Yellowstone National Park (R. McIntyre, U.S. National Park Service,

personal communication). Denali National Park, Jasper and Banff National Parks in Alberta, and several areas of Alaska and Canada outside parks also provide opportunities to observe wolves.

Fairly expensive expeditions to see or hear wolves and their signs are available in Idaho, Minnesota, Alaska, and Canada, as described in magazines devoted to wolves. Businesses on the outskirts of Yellowstone National Park quickly profited from interest in the newly established wolf population. There is growing concern about the effect of tourists on wolves and wilderness environments. Wolf education centers can also be an economic boost to local communities. The International Wolf Center in Ely, Minnesota, brings an estimated \$3 million benefit to the local economy each year and stimulates the equivalent of sixty-six full-time jobs (Schaller 1996).

Wolves also have a certain consumptive value, although that value generally was more important in the past. Sales of pelts in the United States and Canada fluctuate widely because of market demand, ranging from about 21,000 in 1927–1928 to about a thousand in 1956 (Obbard et al. 1987). The number of wolves sold for fur in Canada declined by 40%, from 3,738 in 1983 to 2,285 in 1990, reflecting a general decline in the fur market (Hayes and Gunson 1995). Wolf pelts are still valued for parka trim, fur coats, and rugs and are an important component in the local manufacture of clothing in virtually all Arctic communities in Canada and Alaska, where they provide a significant part of winter income. In Alaska and in Canada's Northwest Territories and Nunavut, wolf harvests remain fairly stable because of this strong local demand for their fur.

Some economic values of wolves are more elusive. Economists have recently developed ways to assess the potential value of nonconsumptive uses of wildlife, such as viewing, and to define preservation or existence value (Krutilla 1967). Many people value simply knowing that wolves exist in the wild, without ever expecting to see or hear one. This type of value can be economically evaluated by asking individuals their willingness to pay, contingent on a hypothetical situation. Using this approach, the existence value of wolves was estimated at \$8,300,000 per year in Yellowstone and \$8,400,000 per year in Idaho (Duffield 1992). Similarly, the benefit from red wolf restoration was estimated to be at least \$18,270,000 per year to the nation and \$3,240,000 per year in eight southeastern states nearest the two reintroduced populations (Rosen 1997). We must note, however, that no attempt was made to similarly assess the negative value wolves

have to other people, which would tend to offset these hypothetical positive values.

Currently the wolf is riding a wave of marketing popularity. Books, magazine articles, conferences, T-shirts, jewelry, paintings, photographs, sculptures, coffee mugs, and audio- and videotapes are all part of the economic activity associated with wolves. The charisma of the wolf has been used—and sometimes abused—to raise funds for conservation and advocacy organizations (Mech 2000b). Appeals for financial support from organizations purporting to be “saving the wolf” have proliferated.

In 1995, a direct mail solicitation from a major pro-wolf organization informed readers that “a war on wolves, begun a hundred years ago, still rages today.” Citing atrocities against wolves committed more than a century ago, the letter went on to convince readers that money is urgently needed “at this critical time . . . in the fight to save America’s wolves.” Such appeals tap the guilt, vague environmental concern, and resources of people, especially in cities, who wish to do something for wildlife and “the environment.” The widespread use of such techniques by environmental organizations to raise funds (\$3.5 billion in 1999) were explored in a recent newspaper series (Knudson 2001). This approach has created problems for wolf recovery and the long-term coexistence of wolves and people and fostered a growing resistance to some environmental causes (Mech 2000b).

Wolf Behavior toward Humans

Overall Reactions to Humans

How wolves react to humans depends on their experience with people. Wolves with little negative experience with people, or wolves that are positively conditioned by feeding, including in parts of the High Arctic, may exhibit little fear of humans (Parmelee 1964; Grace 1976; Miller 1978, 1995; Mech 1988a, 1998a). Perhaps prehistoric humans and wolves feared each other less in open habitat because each species could watch the other from a distance, thus removing some of the mutual apprehension (Stephenson and Ahgook 1975; Hampton 1997). Wolves on the American Great Plains often seemed to be unafraid of humans. Explorer Meriwether Lewis once killed a wolf in present-day Montana with a bayonet (Hampton 1997). Forest-dwelling wolves, however, were rarely observed, thus remaining mysterious and feared, and they themselves were generally afraid of people

(Fogleman 1988; McIntyre 1995). After wolves on the open prairie encountered firearms, they became secretive and elusive.

Denizens of Wilderness?

Society has come to believe that wolves are incompatible with civilization, and to many people, the wolf symbolizes wilderness (Theberge 1975). Mech (1995a) argued that equating wolves with wilderness is an artifact of wolves being exterminated in most areas except wilderness, creating a misconception that they *require* habitat free of human influences to survive. Whereas wolves in some areas of Canada, Alaska, and Russia might never see, smell, or hear a human, most of the world’s wolves live somewhere near people. They encounter the sights, sounds, and scents of civilization in their daily travels.

Human population density in areas occupied by wolves ranges from less than 1 to at least 200/km² (Shahi 1983; Mech 1988a; Promberger and Schröder 1993; Marquard-Petersen 1995). Living near people requires caution about where and when to travel. Behavioral adaptations to humans are most evident in parts of Europe where wolves survived in heavily populated areas. For example, wolves in Italy and Spain avoid activity during daylight (except during foggy or hazy weather) to minimize contact with people (Zimen and Boitani 1979; Boitani 1982, 1986; Vilà et al. 1995; Ciucci et al. 1997). In remote Lapland, wolves are said to be afraid to cross a ski track, while those near the large cities of Finland have learned to move around houses and cross highways while still avoiding contact with humans (Pulliainen 1993). Romanian wolves have entered towns at night, totally unbeknownst to residents (Promberger et al. 1995, 1997). In one area, the animals travel into town in search of food, crossing a large industrial area, a highway, and a busy railroad several times during a night. Italian wolves also enter mountain villages at night in search of food; one pack even denned in an abandoned house (Boitani 1982). In India, wolves regularly live around people, and one pack denned in a concrete pipe (Kumar and Rahmani 2001). In most forested areas of wolf range around the world, however, wolves are rarely seen except in winter by researchers aided by radio-telemetry and aircraft.

Within any wolf population, individuals vary in their caution toward humans and human modifications of the environment (Fox 1972b). Bold individuals may occur in

any population. Less cautious wolves are probably the first to be killed by hunting or trapping, but they can survive when protected. Wolves in protected populations generally are less fearful of humans than those in exploited populations (McNay 2002a,b). Several individuals in protected colonizing populations have demonstrated very little fear. Recolonizing wolves have passed within a few meters of houses and vehicles on many occasions in the Ninemile Valley and Glacier National Park areas of Montana (M. D. Jimenez and D. K. Boyd, University of Montana, personal communication).

Wolves recolonizing Varmland, Sweden, were unusually bold, setting off a debate about whether they had been released by wolf advocates (Promberger, Dahlstrom et al. 1993). Minnesota citizens claim that wolves there are more bold around people after 25 years of legal protection. Nevertheless, wolves on Isle Royale, Michigan, still avoid humans after being protected for over 50 years (Thurber et al. 1994), although they encounter people only during 5 months of the year. Elsewhere, chance encounters between humans and wolves increase during autumn big game hunting seasons, when the number of people in wolf habitat soars and less cautious pups are about.

Wolves enjoy a high degree of protection in North American national parks and often show unusual tolerance of humans in these environments. Wolves in places such as Denali and Yellowstone are often watched at short distances by park visitors. Yellowstone's Druid and Rose Creek packs are regularly observed along the main road as the animals sleep, travel, howl, hunt, and feed.

Wolves show a surprising willingness to live near humans after legal protection. Italian wolves have colonized habitat near the outskirts of Rome. Minnesota wolves have dispersed into open agricultural areas, even though they were raised in a forested environment (Licht and Fritts 1994; Merrill and Mech 2000). Wolves live near a military training facility at Fort Ripley, Minnesota, where they encounter explosions, low-flying aircraft, human shouts, troop movements, and noisy vehicles (Merrill 1996; Thiel et al. 1998). In parts of Spain wolves live primarily in sunflower and wheat fields (Vilà, Castroviejo, and Urios 1993). Clearly, wolves are not wilderness dependent, but their survival depends on the availability of cover that allows them to avoid humans, and on human attitudes that are relatively positive, or at least benign.

Wolves and Roads

One-third of all documented mortality among wolves east of the central Rockies in Canada was related to roads (Paquet 1993), and 75% of human-caused wolf mortality in the U.S. northern Rockies and adjacent Canada occurred within 250 meters of a road (Boyd-Heger 1997). Roads that follow narrow mountain valleys may increase the chance of human-related mortality or substantially alter wolf movement patterns (Paquet and Callaghan 1996). The Trans-Canada Highway and Railroad through Banff National Park, Alberta, accounted for over 90% of local wolf mortality (P. Paquet, World Wildlife Fund-Canada, personal communication).

Thus, roadways can have a strong effect on the way wolves perceive and move about the landscape, and are both a blessing and a curse to wolves. Abandoned roads become travel routes and make travel easier. Secondary roads are often scent-marked in Minnesota (Peters and Mech 1975b) and, like lakes and streams, often represent boundaries between territories. Primary or secondary highways defined 25–90% of the boundaries of the territories of seven of eight packs in Wisconsin (Frair et al. 1996). On the Kenai Peninsula, Alaska, wolves selected or avoided roads depending on human use, and roads influenced the spatial organization of packs (Thurber et al. 1994). Closed roads were preferred winter routes for wolves near Glacier National Park, Montana (Singleton 1995). Wolves commonly use roads in Denali National Park, Alaska (Mech et al. 1998).

Roads that provide access to remote areas can result in vehicle strikes and increased harvest, poaching, or disturbance of wolves. As wolves were just starting to recolonize various areas, they were absent from areas where road density exceeded about 0.6 km/km² (Thiel 1985; Jensen et al. 1986; Mech, Fritts, Radde, and Paul 1988; Fuller et al. 1992; Boyd-Heger 1997). Most recolonizing packs in Wisconsin selected areas with a road density of less than 0.45 km/km² (Mladenoff et al. 1995). However, as recolonization continued, wolves occupied areas where human populations were relatively high and road density was much higher than 0.6 km/km² (Mech, Fritts, Radde, and Paul 1988; Berg and Benson 1999; Merrill 2000; Corsi et al. 1999).

Trains and snowmobiles are also a factor in the wolf's environment. Train tracks often parallel highways, as do pipelines and power lines, thus widening the corridor and increasing the risk for wolves that try to cross or

travel along them. Snowmobile trails are commonly used by wolves because the packed snow allows easy travel. Most use is at night when snowmobile traffic is lowest, but wolves have been seen leaving trails to let snowmobiles pass and then going back to them.

Reactions to Humans Near Pup-Rearing Sites

Wolves vary in their tolerance of human activity around pup-rearing sites. Those not often exposed to humans tend to avoid denning near human activity. However, several den and rendezvous sites have been found within 1–2 km (0.6–1.2 mi) of roads in North America (Jimenez 1992; Mattson 1992; Thiel et al. 1998; Mech et al. 1998) and Italy (Boitani 1986). In remote tundra areas, wolves abandoned dens after people established temporary camps within 1.0 km (0.6 mi) (Chapman 1977, 1979), while some denning wolves in Denali National Park were more tolerant of disturbance (Mech et al. 1998).

Three wolf dens in Yellowstone National Park were located near paved roads (one within 0.4 km), and two became visitor attractions (Smith 1998). Wolves twice moved litters as a result of disturbance by park visitors; the second move resulted in loss of the pups. A Montana pack maintained a rendezvous site at the edge of an active timber cutting operation despite regular low-level helicopter flights directly over the site (Jimenez 1995). Another Montana pack reused its traditional den the year after the area was clear-cut (J. Till, USFWS, personal communication). Thiel et al. (1998) documented active dens and rendezvous sites near active gravel pits, peat mining operations, and military firing ranges, and researchers in Romania found a pack of wolves denning near the city of Brasov (Promberger et al. 1997).

Most countries, states, and provinces provide no special protection for wolf dens or rendezvous sites. However, when wolves were reintroduced to Yellowstone and Idaho, the U.S. Fish and Wildlife Service (USFWS) established the option of closing to humans a 1.6 km area around their active dens and rendezvous sites on public land during the denning season (Fritts et al. 1995). The measure, implemented only once, was intended to protect wolves from disturbance that might cause adults to move pups to another site at too vulnerable an age. In contrast, Denali National Park maintains closures around some dens and rendezvous sites that have been inactive for many years (Mech et al. 1998).

Attacks on Humans

Do wolves attack humans? As already indicated, fear of wolves has been pervasive in human societies. At one time in the 1980s, armed parents escorted their children to school in Whitehorse, Yukon, because they feared wolf attacks, and children in Norway were being bused short distances to school for the same reason (R. D. Hayes, personal observation). A few years later, Montana's U.S. Senator Conrad Burns, opposing wolf reintroduction to Yellowstone, predicted "a dead child within a year" (Fischer 1995). Fear of wolves was an important reason for wolf persecution in both the Old and New World (Young and Goldman 1944; Rutter and Pimlott 1968; Mech 1970; Lopez 1978) and still influences current attitudes about wolves (Kellert et al. 1996).

Cultures that had regular contact with wolves (e.g., Eskimos, American Indians) did not generally regard them as dangerous (Ingstad 1954; Stephenson and Ahgook 1975), although wolves have killed some Eskimos and Indians (Lopez 1978; Hampton 1997). Biblical references (Matthew 10:16) to wolves allude to their ferocity and threat to sheep, but do not describe them as dangerous to humans. Written accounts of wolves attacking humans are far more common in Europe and Russia than anywhere in North America (Mech 1970).

Clarke (1971) reviewed historic reports of wolf attacks in Europe and central Asia and concluded that nearly all incidents involved wolf-dog hybrids or rabid wolves. Rutter and Pimlott (1968) concurred, although Pimlott (1975) believed reports of wolf attacks on children in Spain. Nevertheless, most North American biologists have been skeptical about reported wolf attacks in the United States and Canada and have downplayed wolf danger to humans.

Records of wolf attacks on humans in Europe and Asia are numerous. In 1994, Ilmar Rootsi, of the Estonian Naturalists Society, presented a paper at a conference in Poland entitled "Man-Eater Wolves in 19th-Century Estonia." The report was based on a study of folklore archives, annual reports of clergy, court records, government correspondence, and other press reports and literature. These sources suggest that 108 children and 3 adults were killed by non-rabid wolves in Estonia from 1804 to 1853, but that tame wolves and wolf-dog hybrids were involved in these attacks. Rootsi also found records of 82 registered cases of attacks by rabid wolves from 1763 to 1891, with most occurring in winter and spring.

Cagnolaro et al. (1996) analyzed state and communal archives from the fifteenth to nineteenth centuries in northern Italy and found at least 440 accounts of humans killed by non-rabid wolves. Most were children less than 12 years old. The percentage of children killed was highest in rural areas, while adults were more often attacked near villages or towns. According to these records, 67 persons, including 58 “youths,” were killed by wolves in the Po Valley of Northern Italy between 1801 and 1825.

Mivart (1890; cited in Mech 1970) reported that 161 people were killed by wolves in Russia in 1875 alone. Wolves allegedly attacked people in several regions in Russia during the nineteenth century and earlier, and also in 1944–1953 (Pavlov 1990; Bibikov and Rootsi 1993). Bibikov (1994) suggested that these incidents occurred “during and after [human] hostilities when wolves became accustomed to corpses, or some individuals were to blame that were raised in captivity and became feral.” There are a variety of other reports of wolves scavenging from human corpses (Young and Goldman 1944; Lopez 1978; Shahi 1983; Fogleman 1988; Hampton 1997).

A few attacks on people were reported in Kazakhstan in 1995 and 1996 (Sergei B. Pole to L. D. Mech, personal communication, 12 March 1996), and several fatal attacks were reported in Poland prior to the mid-nineteenth century (Krawczak 1969). Pulliainen (1984, citing Godenhjelm 1981) described a “fairly well documented” case based on church records in which 23 children were killed by a “wolf-like” canid in southwestern Finland during 1878–1881. However, there were no subsequent reports of wolf attacks there (Pulliainen 1993).

Haken Eles reviewed kyrkbocker (“church books”) kept by parish priests in twenty-five Varmland (Sweden) parishes from 1749 to 1859 (Eles 1986; H. Eles, personal communication, 1995). In one parish he found records of a 4-year-old boy “clawed to death” and “mainly consumed” by a wolf in 1727 and a 9-year-old boy killed 25 days later. Church records also indicate that a wolf killed another child during the 1700s. Eles nonetheless concluded that such events were “something very, very rare.”

The most compelling evidence of wolves killing humans recently comes from India. Both Shahi (1983) and Jhala and Sharma (1997) investigated reports of wolves carrying away and eating small children (“child-lifting”) and concluded that some were true. In 1996, the latter

biologists investigated fatal and nonfatal attacks on 76 children, aged 4 months to 9 years, in rural villages of eastern Uttar Pradesh. Over 7 months, attacks occurred about every third day, and children were killed every fifth day on average. Several partly consumed bodies were examined. Evidence pointed to a single bold wolf. The general poverty of the area was thought to contribute to the attacks. Small children were allowed to roam untended. They outnumbered unguarded livestock, and wild prey were scarce. High government compensation payments for the children may have fostered this situation (Jhala and Sharma 1997).

The dearth of fatal wolf attacks on humans in North America following European settlement contrasts with the situation in Europe and Asia. Virtually no early explorer or trapper in the United States and Canada regarded wolves as dangerous (Hampton 1997). Many observers on the Western frontier were astonished that wolves did not kill humans, in view of the stories they had heard (Casey and Clark 1996; Hampton 1997). However, Young and Goldman (1944) described a number of instances of aggression by wolves toward people in various parts of the United States during the nineteenth and early twentieth centuries.

In recent decades, incidents of aggressive behavior in wolves toward humans seem to have increased in North America. McNay (2002b) analyzed eighty cases in which wolves exhibited fearless behavior toward humans between 1900 and 2001, and elsewhere (McNay 2002a) provided detailed accounts of these incidents, which included incidents detailed in earlier studies (Young and Goldman 1944; Mech 1990b; Munthe and Hutchison 1978; Jenness 1985; Scott et al. 1985; The Raven 1997, 1999; Aho 2000; *National Post* 2000) as well as more recent incidents. Aggression by wolves was evident in fifty-one cases. Most incidents were attributed to self-defense, defense of other wolves, rabies, or aggression toward people who were accompanied by dogs. However, nineteen cases of apparently unprovoked aggression involved displays, charges, or bites associated with agonistic or predatory behaviors; eighteen of those occurred after 1968. Among the thirteen biting incidents recorded in cases of unprovoked aggression, eleven involved wolves that were habituated to humans. The apparent increase in aggressive encounters after 1970 was thought to be the result of greater protection for wolves and increased wolf numbers, combined with increased visitor use of parks and other remote areas. These factors have created

increased opportunities for wolf habituation and food conditioning.

Two of the most serious attacks occurred in Algonquin Provincial Park in Ontario, where five people have been bitten in the last 25 years (The Raven 1997, 1999). In 1996, a 12-year-old boy sleeping outdoors was bitten in the face and dragged about 2 meters before the wolf was driven away. In 1998, a wolf grabbed a 19-month-old boy as he played alongside his parents in a campground. The wolf tossed the boy in the air, leaving several puncture wounds on his chest and back before being driven away.

Other wolf-human incidents in North America involved rabid wolves (Chapman 1977; McNay 2002a,b), or were thought to (Peterson 1947). Rabid wolves have rarely killed people in North America, but Native Americans were aware of the danger from rabid animals, including wolves (Young and Goldman 1944; Lopez 1978; Hampton 1997). Currently there is little concern about rabid wolves in Canadian communities in the Arctic, despite epizootic outbreaks in arctic foxes (P. L. Clarkson, Gwitch'in Renewable Resources Board, Inuvik, N.W.T., personal communication). In parts of Eurasia and the Middle East, however, attacks by rabid wolves have been more common (Baltazard and Bahmanyar 1955; Cherkasskiy 1988; Linnell et al. 2002).

Hampton (1997) suggested that the subject of non-rabid wolves preying on humans is "veiled in a hopeless tangle of fact, fear, myth, and folklore passed down through the generations." However, even allowing for exaggerations and fertile imaginations, it is now clear that even non-rabid wolves sometimes attack humans. What is puzzling is why such incidents have been so rare in Europe and Asia in recent years in view of the historical accounts (Linnell et al. 2002). We suspect that a number of factors are responsible, including changes in animal husbandry practices in Europe, where children once herded livestock; the decline of wolves in many parts of Eurasia; and the advent of firearms and consequent selection against wolves that are aggressive toward people. Wolves may have learned that modern humans are especially dangerous and changed their behavior accordingly.

Wolves may perceive humans as being unique in their environment. A human walking upright and wearing clothes is unlike anything else in the wolf's world, and upright humans do evoke strong fear in captive wolves (Joachim 2000). Perhaps the best way to put the safety issue in perspective is to realize that each day millions of people live, work, and recreate in areas occupied by

wolves. Attacks by wild wolves are nonetheless rare, and fatal attacks are ever rarer and hard to document (note especially Linnell et al. 2002 and McNay 2002a,b).

Wolves and Hybrids as Pets

The popularity of wolves and wolf-dog crosses (hybrids) as pets is one manifestation of the modern fascination with wolves (Hope 1994). Ironically, ownership and commercial trade in these animals is yet another form of human exploitation. Some figure that there are more than 100,000 captive wolves and 400,000 hybrids in the United States alone (Hope 1994); others estimate the number of privately owned wolves or hybrids at 8,000 to 2 million (Kramek 1992). However, accurate information about the numbers of these animals and the problems they cause is difficult to obtain.

Keeping wolves as pets has become popular despite the danger and other problems that usually result, and despite recommendations discouraging private ownership (IUCN Wolf Specialist Group Resolution, 24 April 1990). The U.S. Endangered Species Act of 1973, as amended, forbids ownership of pure wolves, but hybrids are subject to little, if any, regulation in all but a few states. Such animals are offered for sale in newspapers for \$250–\$1,500 each. States that try to regulate their ownership encounter complex problems relating to identification; no genetic or other test can consistently distinguish pure wolves from hybrids (see Wayne and Vilà, chap. 8 in this volume).

Hybrids and tame wolves have little fear of humans, are less predictable and manageable than dogs (Mech 1970), and are considerably more dangerous to people (R. Lockwood, American Humane Society, personal communication). Pet wolves and wolf-dog hybrids killed at least nine children in the United States from 1986 to 1994 (Hope 1994), and many children have been maimed. An unknown number of tame wolves and hybrids are released to the wild in the United States (Wisconsin Department of Natural Resources 1999), and distinguishing these animals from wild wolves that are abnormally bold can be difficult or even impossible (Bangs et al. 1998; Boyd et al. 2001).

Wolves Nurturing Humans

Can wolves adopt and rear human infants? The notion that wolves can nurture children occurred in both Eurasia and North America and dates back at least as far as

Romulus and Remus, but this idea has now been debunked (Mech 1970).

Depredations on Domestic Animals

The domestication of animals that began some 12,000–13,000 years ago brought profound changes in the human view of wolves (Boitani 1995). The Sami people (formerly called Lapps) of northern Sweden, for example, changed from respecting the wolf to disdaining it after they began herding reindeer (Turi 1931; cited in Boitani 1995). Over millennia, selective breeding reduced the natural defenses of domesticated animals. Meanwhile, human societies developed more effective means of killing wolves (e.g., the Sami now use snowmobiles and modern rifles).

Depredations on livestock became the primary reason for attempts to exterminate the wolf, first in the Old World and later in North America (Young and Goldman 1944; Bibikov 1982). Wolves preyed on the livestock of European colonists in New England beginning in the 1600s. As settlers advanced westward, so did the wolf-livestock problem. This conflict, along with a host of secondary factors, fueled an outright war on wolves in America for 300 years (Young and Goldman 1944; Lopez 1978).

Depredations on livestock continue to be a major problem in wolf conservation. Wolves prey on domestic animals in every country where the two coexist, killing cattle in Minnesota, reindeer in northern Scandinavia, sheep and goats in India, and horses in Mongolia (Ginsberg and Macdonald 1990). Aside from the economic losses, the very threat of depredation creates stress for livestock producers. Human ingenuity and technology have so far been unable to resolve this conflict, short of eradicating wolves in areas near livestock (Fritts 1982; Mech 1995a). The public and the media are intensely interested in these controversies; human values clash, emotions run high, and misinformation abounds (Blanco 1998; Mech 2000b).

Human tolerance for wolf depredations and ability to combat the problem vary among cultures. Native Americans lost horses to wolves, but did not react with the hostility shown by northern Europeans and Euro-Americans (Hampton 1997). There seems to be greater tolerance for wolf depredations on livestock in the parts of southern Europe and Asia where wolves were never completely eradicated and agricultural societies have adjusted to their presence (Boitani 1995).

Nature and Extent of Depredations

Wolves kill every kind of livestock available to them. Sheep are the most common domestic prey in Europe because of their vulnerability and relative abundance in wolf areas. Aside from turkeys, cattle are the most frequent domestic prey of wolves in North America and greatly outnumber sheep, which have declined sharply in recent decades.

As populations of wild prey were depleted in much of Europe and Asia, livestock became more important to surviving wolves. In the American West, losses of livestock increased following the depletion of bison, elk, deer, and other ungulates and the replacement of those species with cattle and sheep (Young and Goldman 1944). Healthy populations of wild prey have been restored in most parts of North America where livestock are raised, and the proportion of livestock lost to wolves now is generally low (Dorrance 1982; Fritts 1982; Gunson 1983; Tompa 1983a; Fritts et al. 1992; Mack et al. 1992; Bangs et al. 1995, 1998; Treves et al. 2002). We know of no place in North America where livestock compose a major portion of wolf prey, or where wolves rely mainly on livestock to survive.

In Europe and Asia, however, livestock make up a larger part of the wolf's diet, although the proportion varies among regions. In western and southern Europe and the Middle East, wolves have survived in areas with highly degraded natural habitat by eating livestock, livestock carrion, and human refuse. In Gujarat and Rajasthan, India, wolves subsist mainly on sheep and goats because wild prey is scarce outside of preserves (Shahi 1983; Jhala and Giles 1991). In the Hustain Nuruu Reserve of Mongolia, wolves feed mostly on livestock, with over half the diet composed of horses and sheep (Hovens et al. 2002). In an area almost devoid of wild ungulates in northern Portugal, wolves appeared to feed exclusively on livestock, especially goats (Vos 2000). On the other hand, there is relatively little livestock depredation in areas where populations of wild ungulates are healthy (Promberger and Schröder 1993). In Poland (Okarma 1993; Bobek 1995), Romania (Almasan et al. 1970; Ionescu 1993), and Finland (Pulliainen 1965, 1993), depredations on livestock declined after populations of native ungulates were restored. Improved animal husbandry is also thought to be partly responsible for the decline.

Wolves kill dogs wherever the two canids occur, and dogs are an important food for wolves in some areas

(Boitani 1982; Brtek and Voskar 1987; Bibikov 1988; Fritts and Paul 1989; Pulliainen 1993; Bangs et al. 1998; Kojola and Kuittinen 2002). A survey in Croatia indicated that dogs were the most frequent domestic prey of wolves, outranking even sheep (Huber, Mitevski, and Kuhar et al. 1993a). At least twenty-five dogs were killed in Minnesota in 1998 (Mech 1998b), and wolves appear to limit the number of stray dogs in Russia (Bibikov 1988). More compensation has been paid for dogs than for livestock in Wisconsin (Wisconsin DNR 1999; Treves et al. 2002). Attacks on pets in the United States and Finland often occur near human dwellings. Wolves that attacked dogs near homes in Minnesota seemed to focus on them so intently that they temporarily lost their fear of humans (Fritts and Paul 1989; Mech 1990b). If a dog happens to be a beloved companion, the owner experiences an emotional loss and a grieving process (Anderson et al. 1984). In Europe and Wisconsin, wolves often kill hunting dogs, perhaps because they are more likely to be in wolf habitat.

Numbers of Livestock Killed

It is difficult to determine the number of livestock injured or killed by wolves. In the past there was less scrutiny of alleged losses to wolves, so older records should be viewed with caution. For example, Bibikov (1982) cited early Russian reports of about 1 million cattle (0.5% of all cattle available) being killed in the Soviet Union in 1924–1925. As recently as 1987, some 150,000 domestic animals (mainly sheep) were claimed to have been killed by wolves in Kazakhstan, based on a survey of local people (Stephanov and Pole, presentation at 1994 Large Carnivore Conference, Bieszczady, Poland).

In North America, reliable long-term data on livestock losses to wolves are available for Alberta, British Columbia, Minnesota (fig. 12.2), and Montana. (Records are also accumulating from Wisconsin, Idaho, and Wyoming.) Although they are increasing in some of those areas, wolf depredations involve less than 1% of the available livestock (table 12.1), and less than 1% of producers within wolf range experience losses to wolves each year. Information from other states and Canadian provinces suggests a similar pattern (Gunson 1983). However, these figures are all from places where wolves were long ago exterminated from most of the main livestock-producing areas.

The extent of livestock killing by wolves varies greatly by area and by year and is difficult to predict. In Min-

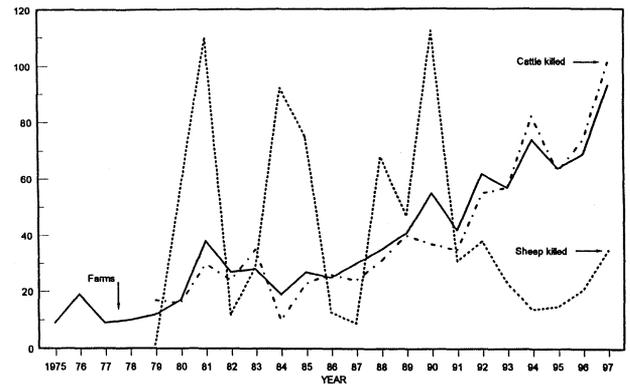


FIGURE 12.2. Numbers of Minnesota farms on which wolves killed livestock and numbers of cattle and sheep verified as killed by wolves.

nesota, there has been less livestock depredation following the most severe winters, apparently because winter conditions increased the vulnerability of white-tailed deer fawns to wolf predation (Mech, Fritts, and Paul 1988; but cf. Fritts et al. 1992). In contrast, the worst year for depredations in Montana (1997) followed an extremely severe winter. The resulting sharp decline in deer in northwestern Montana was believed to be responsible (Bangs et al. 1998).

Number Killed per Attack

The number of livestock wolves kill during an attack is related to the size and abundance of the prey. Most attacks on cattle or horses result in one animal being killed or wounded, whereas more than one sheep is usually killed in one attack. Losses in individual incidents in Minnesota averaged 1.2 animals for cattle, 4.4 for sheep, and 53.5 for turkeys (Fritts et al. 1992). In the Abruzzo region of Italy, the average was 5.9 for sheep and goats, 1.1 for cattle, and 1.1 for horses (Fico et al. 1993). Wolves killed 3 sheep per attack in Tuscany (range 1–18), excluding incidents in which some sheep were killed but not eaten (Ciucci and Boitani 1998b), and 7.6 sheep were killed per attack in Spain (Telleria and Saez-Royuela 1989).

Wolves often kill far more domestic prey than they can eat, especially sheep (Pulliainen 1965; Zimen 1981; Boitani 1982), reindeer (Björvall and Nilsson 1976), and turkeys (Fritts et al. 1992). Wolves killed or injured 34 sheep and 200 turkeys in a single night in Minnesota (Paul and Gipson 1994). Turkeys often panic and concentrate in corners of their pens, where hundreds may

TABLE 12.1. Annual rates of depredations on cattle and sheep in selected areas

Area	Period	\bar{x} no. of cattle killed	Cattle killed per 10,000	\bar{x} no. of sheep killed	Sheep killed per 10,000	Reference
Alberta	1974–90	235	8.9	31	31	Dorrance 1982; Gunson 1983; Mack et al. 1992
British Columbia	1978–80	137	2.3	26	5.4	Tompa 1983a; Mack et al. 1992
Minnesota	1979–97	41	2	42	26	Fritts et al. 1992; W. J. Paul, unpublished data
Montana	1987–97	4.6	0.2	3.8	1	Niemeyer et al. 1994; USFWS 1998 ^a
Wisconsin	1990–97	3	0.3	1.1	3	Wisconsin Department of Natural Resources 1999
Spain (mountainous area)	—	—	—	—	13	Telleria and Saez-Royuela 1989
Tuscany, Italy	1991–95	30	2	2549	35	Ciucci and Boitani 1998b
North Karelia, Finland	1959–63	11	3	103	32	Pulliainen 1965 ^b
Mongolia ^c	1993–97	24	120	121	87	Hovens et al. 2000
India	—	—	—	—	250–670 ^d	Shahi 1983

^aSee also Bangs et al. 1998.^bAdapted from that publication.^cIn and around the Hustain Nuruu Steppe Reserve.^dSheep and goats combined.

die of suffocation. Surplus killing (see Mech and Peterson, chap. 5 in this volume) resulted in 21–113 sheep being killed per attack in Tuscany (Ciucci and Boitani 1998b) and up to 80 in Czechoslovakia (Hell 1993). Excess killing leaves the impression that wolves kill “for fun” and are wasteful, thus enhancing the negative attitude of livestock producers.

Selection of Domestic Prey

Wolves killed more sheep than cattle where both were available in Finland (Pulliainen 1963), and more goats than sheep in India (Kumar and Rahmani 2001) and Portugal (Vos 2000). Depredation rates on sheep (loss/availability) in Minnesota, Alberta, and British Columbia were about 5–10 times higher than on cattle (Mack et al. 1992). In the Carpathian Mountains of Poland (Bobek 1995) and in Tuscany, Italy, 97% of the livestock killed in recent years were sheep (Ciucci and Boitani 1998b).

With cattle, horses, and reindeer, wolves usually attack the young. Calves constituted 67–85% of all cattle killed by wolves in Minnesota, Alberta, British Columbia, and the U.S. northern Rockies (Dorrance 1982; Gunson 1983; Tompa 1983a; Fritts et al. 1992; Mack et al. 1992; C. C. Niemeyer, USDA Wildlife Services, personal communication) and 100% in Wisconsin (Treves et al. 2002). In contrast, wolves appear to select adult sheep and goats

rather than lambs and kids (Gunson 1983; Fico et al. 1993).

Seasonality of Losses

Most livestock are killed during the summer grazing season, which is fairly short in northern areas. Because livestock tend to be on open range longer in more southerly areas, the depredation season there is not as sharply defined. About 83% of all verified losses in Minnesota occur from May through September, when cattle, sheep, and turkeys are on summer range. Depredations on cattle in Minnesota peak during the calving season in May and June; sheep losses peak in July and August; and most turkeys are killed in August and September (Fritts et al. 1992). In western Canada, wolves kill more calves in mid-to late summer than in other seasons (Dorrance 1982; Carbyn 1983a; Gunson 1983; Tompa 1983a; Mack et al. 1992).

In Italy and Spain, wolves attack sheep and goats mainly during August and September, when flocks are on pasture (Brangi et al. 1992; Fico et al. 1993; Telleria and Saez-Royuela 1989; Ciucci and Boitani 1998b). Wolf attacks on cattle in the Abruzzo Mountains of Italy occur mainly during the May calving season (Fico et al. 1993), but attacks on calves continue through September. In Spain's Cantabrian Mountains, wolves concentrate on

cattle, horses, and sheep in summer (Vignon 1995). Most attacks on horses occur during the foaling season (Lampe 1997). The increasing amount of food required by growing wolf pups probably explains the relatively high losses of sheep in August and September.

Wolf Behavior and Livestock Depredations

Considering the availability of relatively vulnerable livestock, why don't wolves kill more of them? Wolves often spend considerable time near livestock without showing much interest in them. Hundreds of wolves in North America surely pass near livestock in their daily travels, especially in summer, yet rarely take advantage of what would seem to be an easy meal. The territories of some recolonizing Minnesota packs bordered farms with livestock, but the wolves were not known to kill livestock or even to venture into open pastures (Fritts and Mech 1981). Since 1980, wolves have occupied the North Fork of the Flathead River in northwestern Montana, where residents raise cattle and horses, but wolves have killed none to date (D. Pletscher, University of Montana, personal communication). A pack territory in Montana's Ninemile Valley includes both private land and grazing leases with hundreds of cattle, yet wolves killed only two during 9 years (M. Jimenez, University of Montana, personal communication). A newly formed pair of wolves dened on Montana's East Front in the middle of an open pasture used by dozens of cows and calves, but walked past the cattle to hunt elk and deer instead (Diamond 1994) and did not kill any cattle for about a year (J. Fontaine, USFWS, personal communication). Biologist Jim Till watched as a radio-collared Montana wolf sighted a calf and immediately charged toward it, only to come to a stop within 2 meters of the startled animal and then casually walk away. In Wisconsin, R. P. Thiel (personal communication) watched a pack walking single file through a herd of cattle, with no apparent reaction by either predator or prey.

These observations and many others tell us that wolves often react to livestock differently than to wild prey. The difference may have something to do with exposure to livestock. Because livestock often inhabit the wolf's environment for only part of the year, wolves may not become sufficiently familiar with them to react as they would to wild prey.

Typically, when North American wolves do prey on cattle, they kill only a few and then resume hunting wild prey. Cattle may not be attacked again for several weeks,

if at all. More vulnerable animals such as sheep, goats, pigs, and turkeys seem to be taken more regularly. Wolf packs in Minnesota sometimes move their pups close to flocks of turkeys in August and September, with the apparent intention of preying on them for an extended period (Fritts et al. 1992).

Few attacks on livestock are actually witnessed, partly because most occur at night (Lampe 1997; Ciucci and Boitani 1998b; Vos 2000). Determining the age, breeding status, or number of wolves involved is rarely possible (Fritts et al. 1992). There is little evidence that wolves that kill livestock are old, injured, or otherwise less able to kill wild prey (Fritts et al. 1992). Pups apparently do not kill livestock in their first summer, except perhaps poultry and small lambs (W. J. Paul, USDA/WS, personal communication).

Husbandry and Depredations

Higher levels of depredations are associated with certain husbandry practices. Untended livestock in remote pastures sustain the highest losses from wolf depredations in both North America and Europe (Fritts 1982; Dorrance 1982; Bjorge and Gunson 1983, 1985; Stardom 1983; Tompa 1983a; Blanco et al. 1992; Paul and Gipson 1994; Bangs et al. 1995; Okarma 1995; Ciucci and Boitani 1998b; Vos 2000). In Alberta, Canada, wolves killed three times more cattle on heavily forested, less managed grazing leases than on pastures where most trees had been removed and cattle were managed intensively (Bjorge 1983, but cf. Mech et al. 2000).

Newborn livestock in remote locations are also much more likely to be killed by wolves (Hatler 1981; Fritts 1982; Tompa 1983a; Paul and Gipson 1994, but cf. Mech et al. 2000). Therefore, delaying the release of newborns onto spring pastures is one way farmers can sometimes reduce losses (Fico et al. 1993; Paul and Gipson 1994).

Poor surveillance of livestock is the most important factor associated with wolf depredations in Italy (Ciucci and Boitani 1998b), Spain (Blanco et al. 1992; Vilà et al. 1995); Karelia (Pulliainen 1963, 1993), Romania (Ionescu 1993), and Russia (Bibikov 1982, 1994). Untended livestock do not always suffer heavy losses, however, even in areas with high wolf populations (Mech et al. 2000). For example, only about 50 sheep are lost each year in the Bieszczady Mountains in Poland, even though large flocks of sheep and other livestock graze untended each summer (Perzanowski 1993).

A third factor increasing the risk of wolf depredations

may be the presence of livestock carcasses (Hatler 1981; Fritts 1982; Tompa 1983a; Bjorge and Gunson 1985; Fritts et al. 1992, but cf. Mech et al. 2000). Carcasses or other edible refuse can attract wolves. In Minnesota, there were several instances in which wolves killed young calves near cattle carcasses close to farmyards (Fritts 1982). Wolves conditioned to livestock in this manner often subsequently kill livestock on neighboring farms (Fritts 1982; Tompa 1983a). Robel et al. (1981) found that sheep producers who buried carcasses or had them hauled away lost fewer sheep to coyotes. However, a study in Minnesota produced equivocal evidence about the importance of carcass disposal in reducing wolf depredations (Mech et al. 2000).

Misperceptions about the Depredation Problem

Agriculturists generally view wolves as relentless killers of livestock. When a few wolves recolonized Scandinavia in the 1970s, there was an uproar (Björvall 1983). Wolves are often blamed for depredations even when evidence points to other predators, including coyotes (Fritts and Mech 1981; Thiel 1993), dholes (Fox and Chundawat 1995), and, especially in Europe, dogs (Salvador and Abad 1987; Magalhaes and Fonseca 1982; Boitani and Fabbri 1983).

Wolf involvement was confirmed in 36% of the complaints of wolf depredation in Alberta (Gunson 1983), 49% in Wisconsin (Treves et al. 2002), 25% in northwestern Montana (E. E. Bangs, USFWS, personal communication), 55% in Minnesota (Fritts et al. 1992; W. J. Paul, USDA/WS, unpublished data), and less than 50% in Italy (Zimen and Boitani 1979; Boitani 1982). Cattle producers in eighteen western U.S. states reported losses of 1,400 cattle to wolves in 1991 (National Agricultural Statistics Board, USDA, 1992), 1,200 of which were reported in states where wolves did not exist (Bangs et al. 1995).

In some newly colonized areas, however, wolves have lived up to their reputation as the archenemy of agriculture. When they kill excessively in reoccupied range, their exploits draw strong attention. For example, a wolf killed 80–100 reindeer in Sweden during one month in 1977 (Björvall 1983). The first pack to colonize France's Mercantour National Park killed 36 sheep in the first year (Lequette et al. 1995).

Even experienced investigators cannot always identify wolf depredation from evidence at a kill site. Clues used to help identify predators include tooth marks,

placement of bites, pattern and extent of feeding, and tracks, scats, and hair left near the carcass (Roy and Dorrance 1976; Wade and Brown 1982; Acorn and Dorrance 1990; Paul and Gipson 1994). Wolves usually bite large cattle and horses on the hindquarters, flanks, and upper shoulders. Young calves and sheep are usually bitten on the throat, head, neck, back, or hind legs (Acorn and Dorrance 1990; Paul and Gipson 1994).

Economic Impacts and Compensation Programs

Carbyn (1987) estimated that wolves in North America cause livestock damage of \$280,000 to \$320,000 annually, equivalent to about \$6 per wolf. The annual market value of losses in Poland is estimated to be U.S.\$32,900 (Bobek 1995). Bibikov (1994) estimated that the value of livestock losses in ten Russian regions in January–May 1986 totaled 2,438 million rubles.

Published estimates of damage on a per wolf basis vary widely, with the highest levels reported in Spain (U.S.\$2,773/wolf/year) and Italy (U.S.\$1,200–3,200/wolf/year) (Blanco et al. 1992). A few farmers and ranchers usually experience a disproportionate share of the losses in a given area.

Compensation programs (Fritts 1982; Fischer 1989) or state insurance (Lampe 1997) help offset economic losses in some areas. From 1977 through 1997, \$658,260 was paid for wolf damage to livestock in Minnesota, Wisconsin, Montana, Wyoming, and Idaho, of which \$81,270 was for 1997 losses. This amounts to about \$30 per wolf per year in the contiguous United States, assuming a total of 2,700 wolves in 1997. In 1989, U.S. livestock and poultry producers reported losing \$138 million to predators (Wywiałowski 1994), suggesting that wolves account for about 6/100 of 1% of the total losses to predation.

Defenders of Wildlife, a nongovernmental organization, established a compensation program to help lower resistance to wolf recovery in the U.S. northern Rockies (Fischer 1989; Fischer et al. 1994). From 1987 through 2000, it paid 134 ranchers \$149,415 for the loss of 173 cattle, 385 sheep, 5 equids, 10 guarding dogs, and 8 herding dogs (H. Fischer, Defenders of Wildlife, personal communication). This program also reimbursed ranchers in the northern Rockies for hay to lure cattle away from a wolf den and for an electric fence, and paid two landowners \$5,000 each for allowing wolves to den and raise pups on their property (H. Fischer, Defenders of Wildlife, personal communication). Compensation pay-

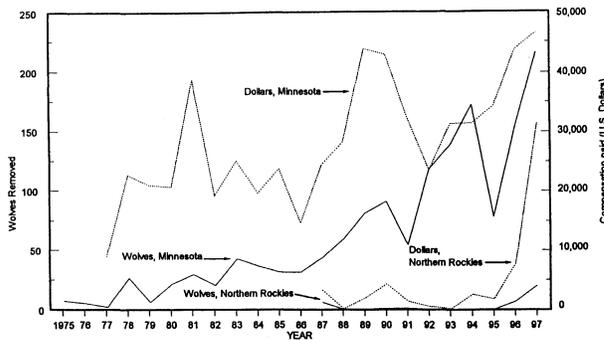


FIGURE 12.3. Numbers of wolves destroyed or placed in captivity by government programs in Minnesota and the northern Rockies because of depredation on livestock and compensation paid to livestock producers for wolf depredations. Additional wolves were captured, but were released on site or translocated. Most problem wolves in the northern Rockies were translocated or released on site.

ments will continue to grow as wolf populations increase (fig. 12.3). Defenders had also paid \$6,008 in compensation for livestock and dogs killed by Mexican wolves reintroduced in the southwestern United States as of December 2000.

Compensation payments are high in Europe. Spain expends U.S.\$1–\$1.5 million annually for damage caused by a population of about 2,000 wolves (Vilà, Castroviejo, and Urios 1993). In Tuscany, Italy, annual compensation for wolf and dog depredations averaged U.S.\$345,000 during 1991–1995; this figure includes damage caused by 80–100 wolves (Ciucci and Boitani 1998b). Payments are highest in Greece, where the government paid full compensation for 2,729 cows and 21,000 sheep and goats from April 1989 through June 1991 (Papageorgiou et al. 1994).

Despite its inherent problems, compensation does play a role in wolf conservation, especially in Europe, where wolf control is not legal (Promberger and Schröder 1993). Fair and timely compensation can help reduce animosity toward wolves. Without it, wolves probably would not survive in some places, but it is not a long-term solution (Wagner et al. 1997). The cost may increase to the point at which the public will demand reduction in payments or in numbers of wolves (Mech, Fritts, and Nelson et al. 1996). Most western European programs do little to ameliorate wolf-human conflict (Lampe 1997), so compensation is viewed as offering only temporary relief rather than an enduring solution (Cozza et al. 1996). In fact, compensation programs

could actually “encourage a state of permanent conflict” (Ciucci and Boitani 1998b) and could result in subsidizing wolf populations that then increase, making the problem worse.

An innovative compensation program has been implemented in the northern half of Sweden, where the Sami have their traditional reindeer-herding areas; the yearly loss to all large predators there is as high as 20,000 reindeer, although most of the damage is done by wolf-herders and bears. Since 1996, compensation for damages caused by large predators has been paid on the basis of verified reproduction or confirmed presence of predators in community grazing areas, and compensation is paid to the local Sami community rather than to individual reindeer owners (Berg and Bjärvall 2000). During 2000, the total cost for this system was 35 million SEK (U.S.\$3.3 million in 2001). Compensation for losses of livestock other than domestic reindeer is paid on the basis of animals killed, but the county administrative boards also contribute funds for measures to prevent damage by predators.

Depredation Control

When wolves prey on livestock, some form of wolf management is usually inevitable, whether lethal or non-lethal, legal or illegal. If the government does not act, livestock owners often try to resolve problems themselves, which can mean indiscriminate killing of wolves. Many biologists believe that government removal of problem wolves is in the best interest of wolf conservation (Mech 1995a). Wolf management in response to depredations on livestock can take several forms.

Lethal Control Methods

It is important to remember that the low rates of livestock losses in the recent past in North America generally happened while there was some degree of lethal wolf control. Depredations would certainly be much higher if not for the removal of problem wolves. Killing wolves to reduce livestock depredation is generally tolerated by the American public (Kellert 1985, 1999), but is subject to increased scrutiny, and the public would prefer nonlethal methods if any were effective (Gilbert 1995; Kellert 1999). However, no consistently effective nonlethal method is anticipated soon (Mech, Fritts, and Nelson 1996).

In the contiguous United States, where the wolf is listed as either “endangered” or “threatened,” only gov-

ernment agents can legally kill or translocate wolves. An exception is that members of “experimental/nonessential” populations in the northern Rockies, Arizona, and New Mexico can be shot by livestock owners if found in the act of killing livestock.

In Canada, wolf control is conducted by government agents and the public. Lethal control by government agents can be either general or specific. General control attempts to prevent losses by removing wolves from certain areas, whereas site-specific actions target only problem wolves. Site-specific control has little effect on wolf populations, and its results are often short-lived. In 2000, all government wolf livestock depredation control in the United States and Canada was reactive and site-specific.

The number of problem wolves removed in several Canadian provinces was less than 100 per year from 1987 to 1991, totaling less than 1% of the population (Hayes and Gunson 1995). The number of wolves euthanized in Minnesota has increased steadily during the past 20 years, with an average of 152 killed annually from 1995 to 1999 (W. J. Paul, USDA/WS, unpublished data). Thus about 5% of Minnesota’s wolf population is killed each year to keep livestock depredations in check, at an annual cost of \$255,000 in 1998 (Mech 1998b). In Montana, about 6% of the wolf population is removed annually, at a cost of \$19,000 (Bangs et al. 1995, 1998). The cost of wolf management in the western United States will undoubtedly increase now that wolves also inhabit Wyoming, Idaho, Arizona, and New Mexico. During fiscal year 2000, Wildlife Services in Idaho spent \$135,880 on wolf control.

Steel-jawed foot traps (Mech 1974b) are used to capture essentially all problem wolves in Minnesota and Wisconsin, but are illegal in Europe. In Montana, 42% of wolves taken for control were taken with traps, and 58% were captured by helicopter. Helicopters can be an extremely effective tool, either to dart and drug wolves or to kill them. This technique, in combination with trapping, has satisfied ranchers’ doubts that wolves can be controlled in the western United States (Niemeyer et al. 1994).

Poisons can be effective, inexpensive, and highly selective in removing problem wolves, although they are poorly regarded by the public. Poison (strychnine and compound 1080) for predator management was banned in the United States in 1972 (Dunlap 1988), but along with traps and snares, is still used on a limited basis in Alberta (Gunson 1992; Hayes and Gunson 1995). Poison

is also used legally in many parts of Russia, the Middle East (including Saudi Arabia, but not Israel), and India and illegally in many parts of Europe, including Spain, Portugal, Italy, and Greece.

Cyanide and strychnine are hard to obtain in Europe, but livestock owners can buy several anticoagulants used to kill rodents. These poisons provide an easy substitute for traps, which are more conspicuous and difficult to use. Before the collapse of the Soviet Union, aerial shooting from helicopters was widely used, but this method has been discontinued because of its high cost. Poison is now preferred and is applied even in protected areas (D. Bibikov, Institute of Animal Evolutionary Morphology and Ecology, personal communication). Poisoning is on the increase in parts of India, and stone pits or deadfall traps are also commonly used there (Fox and Chundawat 1995). Wolves caught in pit traps are killed with stones.

Wildlife managers are sometimes pressured by livestock producers to exercise more lethal control than needed or allowed by law. Clear guidelines governing how wolf control actions can be conducted make the jobs of field personnel easier. Legal actions against the USFWS in Minnesota helped clarify the circumstances under which management of a “threatened” wolf population can occur (Fritts 1982; O’Neill 1988). USFWS regulations required that wolves be killed only *after* they had committed “significant depredations on lawfully present domestic animals” (USFWS 1978).

Nonlethal Methods of Preventing Losses

Several nonlethal methods have been tried for alleviating livestock losses, but none has proved consistently effective (Fritts 1982; Mech, Fritts, and Nelson 1996; Bangs and Shivik 2001). Translocating wolves is an option where lethal methods are illegal or a wolf population is so low that every wolf needs to be saved. However, most translocated wolves move extensively after being released (Fritts et al. 1984, 1985), and the USFWS has recommended that translocations be discontinued in the northern Rocky Mountains (Bangs et al. 1998). Bringing wolves into permanent captivity has also been suggested, but wild wolves adjust poorly to confinement; euthanasia is probably more humane.

One of the oldest nonlethal methods of preventing depredations involves guard dogs. They have been used in Eurasia for centuries, and can be quite effective as long as they are used by trained shepherds (Coppinger

and Coppinger 1982; Adamakopoulos and Adamakopoulos 1993; Hell 1993; Vilà, Castroviejo, and Urios 1993; Promberger et al. 1997; L. Boitani, personal observation). However, in the U.S. northern Rockies, where shepherds are rarely present, wolves have killed several guard dogs (Bangs and Shivik 2001). Promberger et al. (1997) cited inadequate numbers of dogs per herd, inadequate training, proximity of bedding ground to forest, and absence of shepherds as important factors limiting the effectiveness of guard dogs.

Lampe (1997) concluded that guarding of livestock, when done correctly, was effective in reducing losses in Europe. Interestingly, losses appear to be lower in parts of Europe where wolves were never extirpated. There, livestock producers never lost the “know-how” to protect their herds nor developed the attitude that the government should assist them in dealing with wolves.

Many other nonlethal techniques have also been tried. Taste aversion (Gustavson 1982; Gustavson and Nicolaus 1987) did not appear to be effective in Minnesota, and its application elsewhere has declined (Conover and Kessler 1994). The Minnesota program experimented with blinking highway lights, light-siren devices, and surveyors’ flagging on fences to simulate “fladre” used in Europe for funneling wolves during hunting (Fritts 1982; Fritts et al. 1992). Some methods appeared useful in some instances, especially in small pastures, but none was consistently effective. Recently, however, closely spaced and well-maintained fladre seem to have succeeded in preventing livestock losses to wolves on a few ranches (Musiani et al., in press). Fencing, propane exploders, cracker shells, pyrotechnics, diversionary feeding, and other techniques (Cluff and Murray 1995; Bangs and Shivik 2001) have met with only limited success because wolves habituate to them. Fertility control might be useful to limit pup production and wolf density in disjunct wolf populations near livestock (Mech, Fritts, and Nelson 1996; Haight and Mech 1997).

Future Outlook

Controlled experiments to test the effectiveness of different control methods are sorely needed (Fritts et al. 1979). The number of spatial and temporal variables involved make these tests difficult to design. Experience in British Columbia (Tompa 1983a,b), Alberta (Bjorge and Gunson 1985), Minnesota (Fritts et al. 1992), and Montana (Bangs et al. 1995) indicates that the reactive, site-specific wolf removal currently being used usually reduces future livestock depredation problems.

Despite short-term success with a site-specific approach in Minnesota, biologists recommended preventive control where several turkeys and sheep were killed almost every year (Fritts et al. 1992). A zoning system in which the level of control is based on the depredation potential is probably the most effective way to limit losses (Mech 1995a). This approach includes preventing wolves from colonizing areas where the potential for depredation is high, as recommended by the USFWS Eastern Timber Wolf Recovery Team (USFWS 1992). The cost of wolf presence in agricultural areas and the resulting ill will could be substantial and could undermine wolf conservation in the long run (see Boitani, chap. 13 in this volume).

A combination of zoning for wolf population control, indemnity payments, lethal and nonlethal control methods, animal husbandry modifications, and research offers the best hope of balancing wolf conservation with livestock production. At the extreme, some livestock producers may be able to bring livestock into shelters or remain with them overnight. The willingness of farmers and ranchers to make such changes, however, ultimately depends on the cost, the potential for future losses, the feasibility of changing husbandry practices, and the availability of compensation (see Boitani, chap. 13 in this volume).

Wolf Politics and Conflicts among Humans

The conservation and management of wildlife is a complex endeavor in which the biology of animals interacts with human values (Nie 2003). Whether an animal population is lost, restored, or ignored usually reflects human decisions and actions. Wolf management is especially challenging, not only because wolves cause socioeconomic problems, but also because of the universally contrasting viewpoints about wolves. The wolf is one of the most studied mammals there is, and we have most of the information needed to manage it (Mech 1995e). Our understanding of the human aspects of wolf management, however, is more limited, and the application of policy development, mediation, and conflict resolution has only begun (Clark 1993; Haggstrom et al. 1995).

Canis lupus politicus

Wolves have been the subject of political attention since the first bounty was established by Solon of Greece in the sixth century B.C. Predation on livestock has prob-

ably generated more furor than any other facet of wolf-human relations, with wolf control to maintain wild ungulate populations running a close second. Political debate that, on the surface, is about wolves often involves underlying issues that reflect conflict within human societies, especially rural-urban differences.

In some instances, lawmakers recognize exaggerated claims by the livestock industry but ignore scientific data. On the other hand, some wolf advocacy groups minimize existing and potential problems and misinform their members and the public (Blanco 1998; Mech 2000b). Legislators from urban areas, and their constituents, may not sympathize with farmers or hunters in distant parts of the nation, or understand the need to manage wolves.

Throughout most of history, finding consensus and taking action against wolves was easy because most people either supported reducing wolves or didn't care. However, wolf management has become increasingly complex and contentious in recent years. The difficulty in simply defining the degree of protection for wolves in various parts of the world is a good example. Application of the IUCN (2000) classification for threatened species considers only biological criteria. However, individual countries necessarily operate on a national or regional scale and encompass different levels of governmental authority. As the scale becomes smaller, local opinion becomes a greater factor. This is evident in Europe, where local attitudes toward wolves are predominately negative. In North America, national pro-wolf interests now usually dominate local interests. This creates regional hardships and animosity and works against wolf conservation in places such as Alaska, Minnesota, and western Canada where wolf populations are secure and thriving.

Local versus National Interests

Regional and local interests continually compete with national or biological considerations. "State's rights" issues can also come into play. For example, Wyoming legislators tried to reinstate a wolf bounty in 1995 in response to the reintroduction of wolves to Yellowstone National Park. At the national (federal) level, the wolf's legal status reflects the status of wolves nationwide, as well as a national view that wolves should be protected and restored. At the local level (e.g., Montana, Wyoming), the livestock industry and other interests influence state governments, although national laws super-

sede local laws. A similar conflict is evident in most European nations where small numbers of wolves are present; national law is often resented locally. Ideally, a global conservation strategy would be based on population biology and implemented regionally according to local priorities.

One fundamental change in the roles and responsibilities of governments and individuals in wolf management should be noted, however. The payment of compensation for wolf damages is a fairly new development, and the change happened at about the same time as the introduction of economic incentives and subsidies for agricultural products. Although having society share the costs of wolves seems socially appropriate (livestock producers cannot be asked to bear the costs alone, especially when laws prevent them from protecting their interests), this policy leads to a philosophical dilemma. Currently, any damage from natural calamities can be the object of a compensation claim in Europe. This policy increases the separation of humans from the natural environment on both ideological and practical levels.

Local Economies, Conservation, and Wolf Management

Here we explore the relationship between large populations of wolves and the way in which local values are considered in wolf management decisions. Earlier we recognized the importance of depredation control and compensation in making wolf recovery possible where livestock occur. This principle also applies where extensive populations of wolves and wild ungulates coexist with people, and where big game are as important to local economies as livestock are in other areas. Nevertheless, there is a wide range of opinions on and reactions to wolf management in wild systems (Gasaway et al. 1992; Haber 1996; Theberge 1998).

Most of the 60,000 or so wolves in North America inhabit Alaska and Canada, preying primarily on wild ungulates. Although human density is low, hundreds of small communities and dozens of cities are scattered throughout this vast area. Both Native and non-Native people depend on local wildlife resources for economic, material, and spiritual sustenance. Agricultural potential in these northern communities is almost nonexistent, and harvesting local fish and wildlife is a long-standing tradition (Weeden 1985).

The concerted efforts to eradicate wolves that peaked during the late nineteenth century continued during

the 1930s–1960s in western and northern Canada and Alaska (Pimlott 1961; Harbo and Dean 1983; Carbyn 1987; Hayes and Gunson 1995). Since then, attitudes toward wolves have improved, as discussed earlier. In recent decades, only small-scale, temporary wolf control programs have been implemented, and they have adhered appropriately to Principle 7 of the IUCN Wolf Specialist Group's Manifesto on Wolf Conservation, which sets out new, rigid scientific guidelines and conditions for wolf population management. Several such programs in western and northern Canada (Hayes and Gunson 1995) and Alaska (Stephenson et al. 1995) were conducted to allow low or declining ungulate populations to recover.

The Manifesto on Wolf Conservation was of paramount importance to these control programs because its Principle 7 set out clear guidelines for wolf management developed by international conservation authorities. Nevertheless, these efforts generated intense controversies, reflecting fundamental differences in values between rural and urban people. These differences should be evaluated in light of the emerging understanding of the role of local economies and sustainable use of local resources, including wildlife, in long-term conservation strategies.

Biodiversity, Wolf Management and Traditional Uses

The World Conservation Union's (IUCN's) mission statement, called the World Conservation Strategy, includes as a primary objective "to ensure the sustainable utilization of species and ecosystems." The IUCN Specialist Group for the Sustainable Use of Wild Species was formed in the 1990s to promote sustainable local use of wildlife as a primary goal. Sustainable-use principles have been incorporated into conservation biology because classic preservation (i.e., parks and reserves) often failed to protect wildlife and ecosystems, perhaps most notably in Africa (Leader-Williams 1990; Lewis et al. 1990; Saether and Jonsson 1991; deBie 1990).

Conservation models recognizing economic uses by local people have benefited the conservation of African elephants (Leader-Williams and Albon 1988; Leader-Williams 1990; de Meneghi and Kaweche 1990) and of threatened wildlife in South America (Robinson and Redford 1991). Human use of nature can even play an integral role in maintaining biodiversity (Wilson 1992;

Berry 1977, 1987, 1992). However, this approach has not been widely considered in North America.

The definition of conservation embodied in the World Conservation Strategy contrasts with predominant environmental attitudes in developed countries, where the use of renewable resources, particularly large mammals, tends to be regarded as unnecessary and undesirable. The alternative view holds that maintaining healthy economic relationships between human societies and wildlife provides both incentives for conservation and an environmentally sound alternative to the conversion of wild systems to other uses—including domestic food production. The effectiveness of such a conservation model in the North has not yet been objectively evaluated (Herscovici 1985).

These viewpoints conflict with the widely held view of lay environmental organizations that wildlife conservation is best served by minimizing or eliminating consumptive use. Gilbert (1995) concluded that rural people tend to value wildlife for their own use and see wolf control as "utilitarian" because it reduces competition for wild food. Urban people value wolves for "naturalistic" reasons, assuming that "natural" systems are better than managed ones. Wolf predation, however, can hold prey densities down for extended periods, during which little or no harvest is available to people (Hayes and Gunson 1995; Stephenson et al. 1995; see Mech and Peterson, chap. 5 in this volume).

When does wolf control conflict with wolf conservation? According to IUCN principles (Pimlott 1975), such conflict occurs when control is protracted, indiscriminate, and not biologically justified. However, indiscriminate wolf control ended in North America in about 1950, and it is unlikely to recur as long as the current affluence, the resulting availability of alternative resources, and contemporary environmental attitudes prevail.

Mech (1995a), Bangs et al. (1995), and each American wolf recovery plan recognized that some wolf control is needed to provide balance and thus foster local support for recovering wolf populations in the United States. Likewise, wolf recovery in Europe may ultimately depend on the removal of dispersing wolves from densely populated agricultural areas (Boitani 2000). In recent decades, however, environmental groups have campaigned and litigated against wolf control and have usually prevailed over the interests of rural communities.

Wolves and Local Wildlife Values

One of the important results of opposing wolf control relates to the environmental, social, and economic costs of reducing the amount of renewable sustenance obtainable from natural systems by local people (Weeden 1985). Reducing use of natural systems increases reliance on energy-intensive domestic food production and distribution systems that carry a high environmental cost, are not sustainable, and diminish or eliminate wildlife habitat. In other words, when wolves are not controlled, local residents must rely more on domestic than on wild foods, which will affect the environment and natural systems elsewhere.

A major concern of wolf biologists is that demands for complete protection for wolves increase the resistance to wolves and wolf recovery in additional areas (Mech 1995a). Wolf recovery plans recognized the importance of local support early on, and control programs were designed to respond to public demand for livestock protection (Fritts 1982; Bangs et al. 1995; Mech 1995a). However, the economic and political dynamics are the same whether wolves affect privately owned livestock or publicly owned wildlife that humans depend on.

A paradox in the modern debate about wolf management is that the recent expansion in wolf numbers and range in North America and Europe, and the policies that fostered it, were possible because of the affluence of these areas. However, these economies depend on the consumption of tremendous amounts of finite resources, intensive agriculture, and an elaborate transportation network. This affluence has allowed relative tolerance of the predators that sometimes compete directly with humans elsewhere. In less affluent countries, such as Russia, wolves and other predators have been jeopardized because conservation, and especially maintaining predators, is an unaffordable luxury. The future of wolves in affluent countries in many respects depends on how well the elaborate system of production and distribution endures.

In affluent countries, opposing wolf control can be morally gratifying, creating the illusion of doing something positive for the environment. However, few people today, including wildlife managers, support eliminating wolves to maximize ungulate harvest. Rather, the issue is one of balance, of providing a reasonable share of wildlife for both wolves and people. In addition, organized

opposition to wolf control diverts attention from the more important and challenging issue of long-term maintenance of wild lands where wolves can live.

Alaska and Yukon Wolf Management Plans

Earlier we stated that intensive government control of wolves is declining, at least in North America and Europe. Hummel (1995) predicted that some current wolf control methods would end early in the twenty-first century. This may already be happening. Aerial killing of wolves by government agents is the most efficient, effective, and humane method, but is highly controversial (Boertje et al. 1995; Cluff and Murray 1995) and is not practiced anywhere in North America at present.

Recent control programs in Alaska and the Yukon involved killing 60% or more of the wolves in local areas for 3–7 years. While these efforts usually resulted in substantial increases in ungulates (Gasaway et al. 1992) and eventually benefited wolf populations, they also provoked controversy among people who may otherwise share the same long-term objectives for wildlife conservation. Moving beyond such impasses requires negotiation and compromise among diverse interests, as well as a shift from position-based arguments to interest-based negotiations about where, when, and how wolves should be managed.

Are local people capable of caring for northern wildlife—including wolves—or do they simply have a utilitarian view of wolves as unwanted competitors for wild food (Gilbert 1995)? Both Native and non-Native people living in wolf range are only beginning to articulate a rationale for sustainably using wolves and other wildlife, and part of the responsibility for making regional management decisions in the North is shifting from central governments to local communities.

As part of recent land claim settlements in Alaska and northern Canada, wildlife management policies are now based on principles of co-management. Governments, local resource councils, and First Nations share responsibility for wildlife management. Rather than ignoring local values and engendering further opposition from northern communities, some urban conservation interests are pursuing a dialogue with local communities.

When allowed to influence the direction of wolf conservation, northern people have developed progressive and balanced plans. During the 1990s, public planning teams in Alaska and the Yukon Territory produced wolf

management plans that were initially well received (Yukon Wolf Management Planning Team 1992; Haggstrom et al. 1995). Both plans established rigid guidelines for ensuring long-term wolf conservation and guarded against unnecessary wolf control by limiting its scale and duration. The plans also recommended ways to increase human respect for wolves through education, more conservative wolf hunting laws, and recognition of nonconsumptive values. However, both plans were eventually opposed by environmental groups that wanted no wolf control at all.

Another example of successful interest-based negotiation is the Fortymile caribou recovery plan in Alaska and Yukon (Todd 1995; Fortymile Caribou Herd: Management Plan 1995). The goal of restoring this once abundant herd was supported by local residents, conservation groups, and Alaskan and Canadian wildlife agencies. A planning team of government officials and members of the public recommended some new approaches to ungulate recovery. First, the plan was based on principles of fairness and respect for differing views. Rather than attempting to effect a short-term, large-scale increase in caribou, the plan outlined a more moderate approach that required less intrusive methods. Intensive aerial control of wolves was rejected in favor of a combination of public trapping, experimental fertility control, and translocation of wolves. Wolf population control was limited to the caribou herd's post-calving range, where reduced predation was most likely to increase calf survival and herd recruitment. Caribou harvest was reduced to the level required to meet minimum subsistence needs. Public support for the plan was widespread, although some U.S. environmental groups opposed it.

The Fortymile planning process illustrates how consensus on some issues can be found. Compromises and concessions were derived by establishing a fair balance of urban and rural values. A key compromise by rural people involved substituting the experimental technique of fertility control for more effective aerial control. Local people also agreed to reduce the scale of wolf control and to further restrict caribou hunting to show respect for wolves. Environmental groups compromised by recognizing that local people have legitimate concerns and an

interest in participating in wildlife conservation, and by accepting wolf reduction by local trappers.

Conclusion

Many factors, both historical and current, are involved in humans' perceptions of wolves. The status of wolf populations in much of the world has improved in recent decades, largely because human societies have become more urban and affluent and more tolerant of the species. However, attitudes toward wolves continue to be diverse, and the wolf-human relationship is often strained. Wolves are revered as a symbol of wilderness and ecological harmony by some, while others regard them primarily as a threat to human interests. In many parts of the world, especially where livestock are a means of economic survival, people continue to have an antagonistic relationship with wolves that is not likely to change in the foreseeable future.

The wolf's future depends to a large degree on how the values and economic interests of people that live in wolf range are incorporated into wolf management. It also depends on the future status of human economies in North America and Eurasia, and on the degree to which wolf populations can be managed in a way that will maintain predominantly positive, or at least neutral, attitudes toward them. The long-term coexistence of wolves and people will benefit if depredations on livestock and pets can be minimized, and if predation on populations of wild ungulates can be managed to allow a fair share of wildlife for both people and wolves. Ultimately, the survival and well-being of wolf populations will require negotiated compromises that balance the needs, values, and desires of different interest groups with the biological needs of the wolf.

The wolves we imagined at the beginning of this chapter would probably agree that their present circumstances are better than they have experienced for a long, long time. They would also be optimistic about their prospects for coexisting with the human race far into the new millennium. However, they would remain keenly aware that the two-legged species largely controls their destiny.