SPECIES ASSESSMENT FOR GRAY WOLF (*CANIS LUPUS*) IN WYOMING

prepared by

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Introduction

The reintroduction of gray wolves (*Canis lupus*) to the Greater Yellowstone Area (GYA) has been described as one of the most successful wildlife conservation acts of the 20th century (Smith et al. 2003). Their ability to occupy altered and human-dominated landscapes, a well-known capacity for adaptation, and long-distance dispersal capabilities suggest that wolves will occupy much wilderness and non-wilderness in this region. In many parts of Europe and North America wolves have recently recolonized semi-wilderness landscapes. They have become habituated to disturbance and appear to have adapted to increasing disturbance on a population level. One of the key factors in maintaining wolf populations will be the inevitable necessity of wolf control and the backlash from wolf protectionists (Mech 1995a). This is an ongoing dilemma that requires extensive dialogue and public education in order for recovery to be successful.

Natural History

Morphological Description

The gray wolf is the largest of the wild canids. It has a long bushy tail and erect, slightly rounded ears. Legs are longer, feet are larger, and chest is narrower than a dog of similar size. The wolf has long, thick, coarse fur that is typically grizzled gray but that can vary from black through white. The most common pelt colors in the northern Rocky Mountains are grizzled gray and black (USFWS 1994). Average height at shoulder is 65-80 cm; total length (nose to tip of tail) is 1.3 to 1.5 m, with some individuals approaching 1. 8m; and weight ranges from 36-41 kg for females and 41-50 kg for males (Ginsberg and Macdonald 1990).

Coyotes (*Canis latrans*) are much smaller with narrower muzzles and black-tipped tails that are held down during running, in contrast to wolf tails which are held more erect.

Taxonomy and Distribution

Taxonomy

Twenty-four subspecies of wolves have been recognized in North American (Hall 1981). However, recent studies, using multivariate techniques, suggest that this number reflects variation among individuals rather than geographically separated subspecies (Bogan and Mehlhop 1983, Nowak 1983). Generally only five subspecies are now recognized: *C. l. occidentalis*, of most of Alaska and western Canada; *C. l. nubilus* of most of the western United States, southeastern Alaska, and central and northeastern Canada; *C. l. lycaon* of southeastern Canada and the northeastern United States; *C. l. arctos* of most of the Canadian Arctic islands and Greenland; and *C. l. baileyi* of Mexico and the extreme southwestern United States.

In Wyoming, three subspecies were recognized previously: *C. l. irremotus* over most of the state, *C. l. youngi* in the southeast corner, and *C. l. nubilus* in southern Wyoming (Clark and Stromberg 1987, Long 1965). With the revision discussed above, only one subspecies is recognized in Wyoming, *C. l. nubilus*; the former *C. l. irremotus* and *C. l. youngi* are subsumed into this taxon.

Distribution

Until the mid-nineteenth century gray wolves existed throughout most of North America, including the entire Rocky Mountain cordillera. Gray wolves were apparently absent only from southern Mexico and the Gulf Coast region; the latter area was occupied by the red wolf *(Canis rufus)* (Figure 1) (Nowak 1983, Young and Goldman 1944). Settlement of the continent by Europeans involved widespread reduction of native ungulate populations, introduction of livestock, and direct persecution of wolves (Lopez 1978, Young and Goldman 1944). By the 1920's wolves were gone from most of the United States; by the 1940's they persisted only in isolated locations, including the northern Great Lakes region (where they continue to persist today) and portions of the northern Rocky Mountains (Thiel and Ream 1995). Throughout the mid-20th century wolves from Canada occasionally dispersed into Montana and Idaho (Ream and Mattson 1982), though they failed to persist in the area (Pletscher et al. 1997).

In the late 1970s wolves began dispersing into the mountainous areas near Glacier-Waterton Lakes National Parks in Alberta, Canada, just north of the Montana border (Ream and Mattson 1982). In 1985 a pack of 12 wolves from Alberta colonized Glacier National Park (Robbins 1986). Breeding was documented in 1986, for the first time in 50 years in the U.S. (Ream et al. 1989), and by 1992 at least 50 individuals were known to reside in at least four packs along the continental divide of Montana (Fritts et al. 1995, Pletscher et al. 1997, Ream et al. 1991). Wolves were documented in Idaho since the early 1980s. Prior to human-mediated reintroduction in 1995, lone wolves occasionally ventured into the GYA; a single wolf was documented in northwestern Wyoming in 1992 (Fritts et al. 1995).

After many years of effort and planning, wolves were reintroduced into the GYA in 1995-1996. This effort targeted large tracts of federal public lands (primarily Yellowstone National Park [YNP] and surrounding USDA Forest Service Wilderness Areas) that supported large populations of wild ungulates and had a relatively low likelihood for wolf-human conflicts. Today wolves are found throughout northwestern Wyoming, largely in the GYA. There are 14 packs in YNP, and 7 that spend most of their time in Wyoming (WGFD 2003). Numerous sightings of wolves suggest that they roam over much of western Wyoming. The known distributional extent of wolves originating from the GYA is the Bighorn Mountains near Ten Sleep to the east, the town of Morgan, Utah, to the south, and central Idaho to the west (M. Jimenez, personal communication). Peripheral Wyoming sightings include areas near Meeteetse, Worland, and Thermopolis; wolves are also routinely seen around Kemmerer and Cokeville, and have recently been sighted near Wamsutter (Gray Wolf Status Reports, at http://www.westerngraywolf.fws.gov).

Habitat Requirements

General

Wolves are habitat generalists and historically occupied most habitats in the Northern Hemisphere, including all of Wyoming, and populations flourished in areas with plentiful large prey (Fitzgerald et al. 1994, Long 1965, Mech 1970). Currently it appears that abundant ungulate prey, secluded denning and rendezvous sites, and relatively low levels of human activity are the general habitat requirements for wolves (USFWS 1987).

Habitat requirements of wolves in 56 wolf packs in the northern Rocky Mountains was studied by relating landscape and habitat features found within the pack boundaries to those found in adjacent areas that were not occupied. Wolf packs occupied areas with more forest cover, lower density of humans, higher density of elk (*Cervus elaphus*), and lower density of domestic sheep (Oakleaf 2002, Oakleaf et al. in review). The study also found large tracks of suitable unoccupied habitat into which wolves are likely to expand.

In the northern Great Lakes Region, low densities of roads and low fractal dimension of vegetation patches (i.e., simpler, rather than more complex, patch shapes) were the most important predictors of wolf recolonization in logistic regression models (Mladenoff et al. 1995). Wolves moved throughout the landscape, including unfavorable areas, but long-term establishment was restricted to more roadless areas with relatively large and simply-shaped patches of vegetation. In this same area, wolf pack territories were negatively correlated with amount of agricultural land, small-parcel private ownership, road density, and human population density (Mladenoff et al. 1999). A positive relationship was found with coniferous forest cover and county-managed forest lands. Logistic regression models with road density as the best predictor variable correctly classified 12 of 14 existing pack areas and 12 of 14 nonpack areas. The model correctly classified 18 of 23 newly established packs into favorable areas. A road density threshold of 0.45 km/ km^2 best classified pack and nonpack areas (Mladenoff et al. 1995, 1999).

In Minnesota, the entire range of the wolf was evaluated in terms of road density. The mean road density of areas inhabited by wolves was 0.36 km/ km^2; it was 0.81 – 0.88 km/ km^2 in areas without wolves (Mech et al. 1988). These results were consistent with earlier studies in Wisconsin that found that wolves failed to persist at road densities above 0.58 km/ km^2 (Thiel 1985).

Human activities associated with highways, roads, and other linear corridors cause fragmentation of wolf ranges and result in the death of wolves (Paquet and Carbyn 2003). Persistent occupancy of wolves is usually assured at road densities below 0.6-0.7 km/ km^2. High-road densities typically result in many different forms human-caused wolf mortality, including vehicle collisions and increases in legal and illegal shooting, trapping, and poisoning. In areas of high road densities wolves sustained high human-caused mortality and did not survive at levels that would sustain a population (Mech 1989). Such areas can act as population sinks if there are large adjacent reservoirs of occupied wolf range.

Wolves also appear to avoid snowmobile activity. In Voyageurs National Park in Minnesota, wolf activity was absent during the times that snowmobile incursions occurred (USDOI 1996). In the Great Lakes areas, wolves avoided agricultural lands and deciduous forest, and favored forests with at least some conifer component, such as mixed deciduous-conifer forest areas and forested wetlands (Mladenoff et al. 1997). In the Bow River Valley in Alberta, Canada, use of habitat types was related to human use levels and habitat potential (Paquet and Carbyn 2003). Alienation of wolves occurred when more than 10,000 people/ month used an area, regardless of other habitat features. Wolf use patterns were altered at lower human use levels as well.

In the Canadian Rocky Mountains wolves were affected by topographic complexity and elevation. Wolves concentrated in broad river valleys during the winter, where elk concentrations were higher and movement was less restricted by snow (Callaghan 2002).

Denning

The first wolf den found in recent years in the U.S. consisted of five den openings on a flat, forested knoll adjacent to a meadow. The den openings were hidden in Engelmann spruce (*Picea engelmanii*), Douglas-fir (*Pseudotsuga menziesii*), and lodgepole pine (*Pinus contorta*); the meadow was thought to be used as a rendezvous site (Ream et al. 1989). Dens in northwest Montana and the Canadian Rockies are typically located in valley bottoms and lower slopes, with flat to moderate slopes, on south and east aspects, on depositional landforms, at sites close to trails, far from human habitation and activity, and close to meadows and other openings (Matteson 1992). Dens are frequently used repeatedly and thus den sites represent a significant habitat element for wolves.

Wolves do not tolerate human activity near dens and pups, although researchers have been able to make observations without disturbing the animals. Disturbance can cause desertion of home sites. Some dens have been located within 2.4 km of roads and campgrounds, possibly indicating that wolves are adapting to human activity and disturbances in some areas (Mech 1995a, Paquet and Carbyn 2003).

Movement and Activity Patterns

Dispersal

Wolves expand their range via dispersal; dispersing individuals typically settle into unoccupied territories or assimilate into established packs within 50-100 km of their natal pack (Gese and Mech 1991, Wydeven et al. 1995). Dispersers can account for 10%-30% of individuals in a wolf population (Gese and Mech 1991). Wolves have a tremendous capacity for travel and can move over very large areas. Alaskan wolves have dispersed hundreds of kilometers from their natal range (for example, from Denali National Park to the Alaskan National Wildlife Refuge) (Stephenson et al. 1995). Dispersers in the central Rocky Mountain recovery area have moved up to 800 km (Ballard et al. 1983, Boyd and Pletscher 1999). This mobility sets the stage for significant genetic mixing across broad regions and long-distance recolonization of vacant habitat (Stephenson et al. 1995).

Dispersing individuals may move to unoccupied habitat near their natal pack's territory or they may move several hundred miles before locating vacant habitat, a mate, or joining another pack (Mech 1970). Dispersal seems to peak in January-February, when intraspecific aggression is high, and again in May-June (Ballard et al. 1987, Boyd and Pletscher 1999). Dispersers in colonizing populations have been found to move, find mates, and establish territories quickly (Boyd and Pletscher 1999, Fritts and Mech 1981). In a colonizing population, males and females dispersed in proportion to their numbers in the source population, and generally when they were between two and three years old (Boyd and Pletscher 1999). When settled into a new territory, dispersers produced more litters than did animals that did not disperse.

Between 1995 and 1999, the Yellowstone Wolf Project documented 36 dispersal events (18 females and 18 males) (Smith et al. 2000) with males dispersing an average of 86 km and females an average of 64 km. Dispersals have been documented among and between all three recovery areas in the northern Rockies (Bangs et al. 1998, Mack and Laudon 1998, Smith et al. 2000) and into adjacent states (Washington, Oregon and Utah). Dispersal paths crossed international boundaries, state boundaries, public and private land boundaries, and different land uses and agency jurisdictions (USFWS et al. 2000).

Dispersal appears to occur across a diverse range of topography and vegetation rather than through well-defined corridors (Boyd and Pletcsher 1999). Consequently, it is not possible to define dispersal habitat. Established packs often react aggressively to dispersing individuals, sometimes injuring and killing them. The behavioral determinants of assimilation vs. rejection of dispersing individuals are not well understood.

Migration

Wolves are essentially non-migratory, although they range over vast areas and move in predictable seasonal patterns in response to snowpack and ungulate distribution.

Daily Activity

Daily activity consists of searching for prey, testing prey, making a kill, feeding, resting, and socializing (greeting, communicating, and affirming dominance relationships). Packs maintain territories that vary greatly in size and are likely related to prey density (Ballard et al. 1987, Fuller 1989), and therefore the quality of prey habitat. Pack territories in the GYA average 535 km^2 (WGFD 2003). Packs patrol territory borders as well as major travel routes within the territory, and scent mark liberally (Halfpenny 2003). Intruding packs and individual wolves are aggressively chased, sometimes resulting in injury and death.

Reproduction and Survivorship

Breeding and Social Behavior

Wolves are social animals that live in packs, the core of which are typically formed by a dominant pair and their young, including yearlings and older, non-breeding wolves. Other pack members may or may not be related to the dominant pair (Meier et al. 1995). Packs of up to 36 have been reported (Rausch 1967). In YNP in 2001, there were 110 wolves in 10 packs ranging in size from 2 - 37 wolves, with an average pack size of 13.1 (USFWS et al. 2002). In Wyoming outside of YNP in 2001, there were at least 56 wolves in 7 packs ranging in size from 2 - 12 wolves, with an average pack size of 8.7 (Table 1).

The dominant pair in a pack produces most of the offspring, although 20 - 40% of packs consisting of two or more reproductively mature females produce more than one litter per year (Mech 1991). In Wyoming, litter sizes averaged about five pups from 1997-2001 (USFWS et al. 2002). Pups begin to hunt with the pack by early fall. Most animals will disperse from their natal packs when they are one to three years old (Fritts and Mech 1981, Wilson and Ruff 1999).

Breeding Phenology

Breeding occurs in late winter (February-March) and pups are born at a den site after a gestation of 63 days, in late-March - April. Wolves prepare den sites weeks before pups are born. Wolf rendezvous sites are used for resting and congregating, especially during summer and early fall. Often a succession of rendezvous sites are used. The first one is used from late May to early July when the pups are 6-8 weeks, and is typically just a few miles or less from the den site (USFWS 1987).

Breeding Habitat

No particular habitat type is sought out for breeding behavior. Ungulate calving and fawning sites are important in May and June and serve to provide an abundant and easy food source to feed pups and lactating females.

Fecundity and Survivorship

Wolves have a high reproductive potential, and established wolf populations can sustain moderate levels of mortality. Annual mortality rates of >30% of a given population generally result in a population decline (Keith 1983). Wolf density in unexploited populations is most likely limited by prey availability (Fuller 1989). Litter size increases when there is greater ungulate biomass per wolf (Boertje and Stephenson 1992). Causes of mortality include starvation, intraspecific aggression, accidents, and human exploitation. On Isle Royale, where human-caused mortality does not occur, mortality from starvation and intraspecific aggression (in response to low prey density) ranged from 18% to 57% during a 20-year period (Peterson and Page 1988). Under extremely good conditions a wolf population can increase by 50% per year (Hayes 1995). High prey density and vulnerability, multiple litters in a pack (Ballard et al. 1987, McNay 2002), and immigration of dispersing wolves can all contribute to an increasing wolf population. Wolf packs and population data for wolves in Wyoming are shown in Table 1. Since 1998, the GYA wolf population has grown on average of 22% per year (see Figure 2).

Eighty percent of mortalities in and near Glacier National Park were human-caused; of these, 84% occurred within 200 m of a road or seismic line (Boyd and Pletscher 1999). Wolves killed by humans died closer to roads than nonhuman mortalities. Other causes of wolf mortality in this study included one wolf killed in an avalanche, three killed by other wolves, one killed by an elk, and one unknown.

Population Demographics

Once wolves were reintroduced to the GYA they were very successful in forming packs, reproducing, and expanding their range. Forty-one wolves were transplanted to GYA from Alberta and British Columbia between January 1995 and spring of 1997. In late 2003, the GYA supported approximately 301 wolves, with 235 in Wyoming (USFWS et al. 2004).

Limiting Factors

Several factors can limit or regulate growth of wolf populations: prey availability (especially ungulate biomass), disease, and human-caused mortality (Paquet and Carbyn 2003). Some research indicates that once a population reaches a limiting density territorial behavior will regulate the number of breeding units (packs) and social dominance will limit the number of breeders within a unit. Others argue that high wolf densities will sharply reduce prey populations, leading to a drop in wolf densities; when prey populations recover, wolf densities increase in response. It is likely that each of these scenarios, and combinations of the two, occur depending on environmental conditions, diversity of prey and other predator species, and landscape constraints on immigration / emmigration (Paquet and Carbyn 2003).

The rate of annual mortality that a wolf population can sustain depends on a number of factors including pack size, population structure, immigration and emigration, and degree of multiple denning within packs (Paquet and Carbyn 2003).

Metapopulation Dynamics

Although it is unclear if wolves in the western U.S. form a true metapopulation, individuals are known to move between the three subpopulations (central Idaho, western Montana, and northwestern Wyoming) in the region (M. Jimenez, personal communication). Regular movement of individuals between subpopulations is considered to be a prerequisite of successful recovery in the Rocky Mountains (WGFD 2003). An analysis of movement corridors connecting the subpopulations indicated that there is greater connectivity between Idaho and Montana populations than between either of those and the GYA (Oakleaf 2002, Oakleaf et al. in review). Conservation of appropriate movement corridors in Idaho and Montana may be one of the most important actions in maintaining wolves in Wyoming over the long term.

Genetic Concerns

Because the genetic variation of wolves introduced into Wyoming was relatively high, and because Wyoming populations import individuals from other areas at least occasionally, there is currently little concern about inbreeding in Wyoming wolves (Forbes and Boyd 1997). Maintenance of regular immigration will be important over the long-term (USFWS 1994). Because wolves can traverse many different habitats and terrains, connecting movement corridors probably do not need to be composed of specific vegetation types or topographies. Rather, such corridors may take the form of zones in which human-caused mortality is minimized via legal statutes and public education (Forbes and Boyd 1997). There are no specific movement corridors proposed for wolves within the state of Wyoming (WGFD 2003).

In Denali National Park and Preserve, Alaska, there was more genetic similarity between packs and less within packs than would be expected if packs were simply composed of an unrelated pair and their offspring (Meier et al. 1995). This is consistent with our general knowledge of pack formation, breeding, and dispersal: new packs form from local dispersers, unrelated wolves are accepted into existing packs, and there may be multiple breeding females within a pack.

Food Habits

Food items

Wolves are opportunistic predators that feed primarily on ungulates, though they will also take small mammals. Beavers (*Castor canadensis*) are an especially important secondary prey species (following ungulates in general) in some areas (USFWS 1994). In YNP and adjacent areas elk have been the primary ungulate taken by wolves (> 85% of documented kills), followed by bison (*Bison bison*; 2%), deer (*Odocoileus* spp.; 2%), moose (*Alces alces*; 0.5%), and pronghorn (*Antilocapra Americana*; < 0.5%) (Mech et al. 2001, Ripple et al. 2001, Smith et al. 2000, USFWS et al. 2002). Most elk killed in GYA were calves, adult females, or individuals with low marrow fat; adult elk taken by wolves were older than the mean age, by sex, of the local elk population (Mech et al. 2001). In Riding Mountain National Park, Canada, elk were the main food base and the kill rate was one elk / wolf / 14 days (Carbyn 1983).

The recovery area in the GYA encompasses primarily federal land and comprises 64,000 km^2 (USFWS 1994). It includes an estimated 100,000-250,000 wild ungulates; in rough order of abundance these are elk, mule deer (*O. hemionus*), bison, moose, pronghorn, bighorn sheep (*Ovis canadensis*), and mountain goat (*Oreamnos americanus*) (Bangs et al. 1998, Mech et al. 2001).

Wolves will also take domestic livestock. In the western U.S., the real and perceived impact of predation on livestock was a major factor in the extirpation of wolves (Young and Goldman 1944). Across the livestock industry losses due to wolf depredation are few (Table 2); however, individual ranchers can, for a variety of reasons, sustain significant loss (Fritts et al. 1992, Mack et al. 1992). In addition to direct loss, indirect costs may accumulate because of increased management activities, required changes in husbandry practices, or uncompensated losses. The non-profit group Defenders of Wildlife (Washington, DC) has, since 1987, made compensation payments of approximately $360,000 for wolf depredation of livestock and guard dogs (http://www.defenders.org/wolfcomp.html).

Foraging Strategy

Wolves are cursorial predators that typically hunt cooperatively in packs. An Idaho study found that both wolves and mountain lions (*Puma concolor*) killed primarily juvenile elk (51%), followed by adult females (46%) and adult males (3%). Although there was essentially no difference in these proportions between mountain lions and wolves, the nutritional status (as measured by bone marrow fat) of wolf-killed elk was poorer than that of elk taken by lions (Husseman et al. 2003). Wolves chased prey farther, and had lower capture successes, than lions. It is reasonable to assume that the cursorial hunting style of wolves will result in the taking of individuals in poorer condition relative to the stalk-and-ambush style of lions (Husseman et al. 2003, Mech et al. 2001).

Foraging Variation

In areas where white-tailed deer are the main prey it appears that newly-arrived (i.e., colonizing) wolves kill a higher proportion of fawns as compared to established wolf populations (Boyd et al. 1994, Fritts and Mech 1981). The kill success rate varies seasonally. In the GYA from 15 November to 15 December, when elk are in good condition, the kill rate is lower than during the month of March, when elk are in poor condition (J. Halfpenny, personal communication).

Community Ecology

Carnivores affect prey directly and indirectly, and can exert influences that cascade through the trophic levels of an ecosystem (Estes et al. 2001, Miller et al. 2001, Reed 2003). Carnivores such as wolves can reduce prey abundance via predation (Schoener and Spiller 1999); they can also change prey distribution as prey animals change their behavior to avoid predation (Brown 1999, Schmitz 1998). Long-term monitoring on Isle Royale has shown that wolves affects the number and behavior of moose, which in turn affects the species composition and soil nutrient dynamics in forest stands (McLaren and Peterson 1994, Post et al. 1999).

It has been estimated that aspen (*Populus tremuloides*) historically covered 4-6% of the northern range in YNP (Houston 1982). As elk populations increased throughout the 20th century (Weaver 1978), aspen coverage declined to about 1% of its previous distribution (Ripple et al. 2001). Additionally, aspen stands changed from persistent collections of individuals in multiple age classes to declining stands of only mature trees (Meagher and Houston 1998). Elk browsing can eliminate aspen seedlings and promote fungal infections of older individuals via bark scarring, and has been implicated in aspen decline in GYA (YNP 1997, Ripple et al. 2001). The long term loss of aspen, and similar declines in willow (*Salix* sp.), in the GYA has in turn been implicated in reductions in the density and distribution of passerines and beaver in the area (USFWS et al. 2003).

Human-mediated removal of elk during the 1960s had no effect on aspen stem recruitment (Ripple and Larsen 2000). Aspen is highly palatable to elk, so even with fewer animals, their selection for aspen effectively suppressed regeneration (Ripple et al. 2001). Since the reintroduction of wolves into YNP, elk have comprised 80-90% of observed wolf kills (Mech et al. 2001, USFWS et al. 2003). Monitoring since the reintroduction suggests that elk have changed their use of the landscape by avoiding areas frequented by wolves, and that aspen sucker heights are significantly higher in areas frequented by wolves (Ripple et al. 2001).

The absence of wolves may have also allowed for greater herbivory on willow communities, which in turn caused a decline in density of neotropical birds (Berger et al. 2001). Current research projects have hinted at a reversal of this trend since the reintroduction of wolves (T. Stephens, BLM, personal communication).

In addition to the interactions between wolves and their prey and vegetation, wolves affect the carnivore community. Wolf kills are a consistent source of carrion to many scavengers, including both black (*Ursus americanus*) and grizzly (*U. arctos*) bears, wolverines (*Gulo gulo*), red foxes (*Vulpes vulpes*), eagles, and corvids (USFWS et al. 2003). Ravens appear, on average, within two minutes of wolves making a kill (Berger 2002). Berger (2002) estimated that in the GYA there is three times as much carrion available to scavengers now than before the wolf reintroduction. Coyotes, are heavily preyed upon by wolves, and their distribution and abundance have both declined since wolf reestablishment in the GYA (Crabtree and Sheldon 1999, USFWS et al. 2003).

Conservation

Conservation Status

U.S. Fish and Wildlife Service

The gray wolf in the conterminous 48 states was listed as Endangered under the Endangered Species Act (ESA) in 1974 (16 USCS 1531-1544). The eastern subspecies (*C. l. lycaon*) was listed as Endangered in Minnesota and Michigan, and the northern Rocky Mountain subspecies (*C. l. irremotus*) was listed as Endangered in Montana and Wyoming (USDOI 1974). A third subspecies, the Mexican wolf (*C. l. baileyi*), was listed as Endangered in 1976. In 1978 the USFWS published a rule that re-listed the gray wolf at the species level (*C. lupus*) as Endangered throughout the lower 48 states and in Mexico (43 FR 9,607, March 9, 1978). In the Great Lakes region the gray wolf was reclassified as Threatened, and critical habitat was listed in Isle Royale National Park and portions of Michigan and Minnesota.

A wolf recovery team for the northern Rocky Mountain (NRM) region was appointed in 1974 and a Recovery Plan was approved in 1987 (USFWS 1987). Recovery areas in northwest Montana, central Idaho, and the GYA were identified based on the presence of an adequate year-round prey base; at least 3000 mi^2 (7770 km^2) of contiguous wilderness, national parks, and adjacent public lands; a maximum of 10% private land; the absence, if possible, of livestock grazing; and isolation from populated and heavily used recreation areas (USFWS 1987).

In 1995 and 1996 USFWS reintroduced 66 wolves from Alberta and British Columbia into the wilderness areas of central Idaho and YNP as nonessential, experimental populations (59 FR 60252, November 22, 1994) under Section 10(j) of the ESA (16 USCS 1539(j)) with the goal of reestablishing a sustainable gray wolf population in the northern Rocky Mountains (Wyoming, Idaho and Montana) (Bangs et al. 1998).

USFWS established that the reintroduced wolves in the NRM region would comprise an experimental, non-essential population. At the same time, USFWS established a rule under § 4(d) of the ESA that gives USFWS flexibility in responding to wolf-human conflicts outside of the experimental population areas (68 FR 15804). The 4(d) rule allows landowners and permittees who have Federal grazing allotments to non-injuriously harass wolves without a permit, injuriously harass wolves with a permit, or kill a wolf in the act of attacking livestock or herding or guarding animal (68 FR 15804 at 15,828).

The USFWS has defined a recovered wolf population in the northern Rocky Mountain Recovery Area as one that contains at least 30 breeding pairs of wolves (an adult male and female raising two or more pups-of-the-year until December 31), with an equitable and uniform distribution throughout the three states for three consecutive years (USFWS et al. 2003). The USFWS found that 2003 was the fourth year in which at least 30 breeding pairs of wolves inhabited the northern Rocky Mountain Recovery Area and the population of 754 wolves had achieved biological recovery objectives (USFWS et al. 2004). If the wolf population remains at least at current levels and distribution, and state management plans are developed and approved by USFWS, the USFWS may publish its proposal to delist gray wolves in the northwestern United States.

On 1 April 2003 USFWS identified three Distinct Population Segments (DPS) of gray wolves in the lower 48 states (68 FR 15,804-15,878); Eastern DPS, Western DPS, and the Southwestern DPS (Figure 3). To qualify as a DPS, a group of vertebrates must satisfy criteria of both discreteness and significance (61 FR 4,722, February 7, 1996). USFWS found that each of these segments comprised a group of wolves that was geographically separated from the other groups—they are "discrete" (68 FR 15,804 at 15,819), and each of these groups demonstrate unique evolutionary lineages and that the loss of any one would result in a substantial range gap—they are "significant". USFWS concluded that these three DPS represent separate "reservoirs of diversity" and thus warrant reclassification reflecting this uniqueness.

The Western DPS completely encompasses California, Idaho, Montana, Nevada, Oregon, Washington, Wyoming, and Utah north of U.S. Highway 50, and Colorado north of Interstate 70. Wolves that are part of an experimental population are not included in the DPS (68 FR 15,804 at 15,818). When FWS established the non-essential, experimental populations in the NRM area, the rule stated that this status would not be changed until the wolf populations were delisted (USFWS 1994). Thus there are two classifications based on geography in the NRM area: the Western DPS and the non-essential, experimental populations. With downlisting, all of the wolves in the NRM area are managed under almost identical rules, the 4(d) rule applied to the Western DPS and the regulations applying to the experimental population (68 FR 15,804 at 15,832).

The rule reclassifying gray wolves into three DPSs also downlists wolves in the Eastern and Western DPSs from Endangered to Threatened, except where they were already listed as Threatened or as an experimental population. Wolves in the Southwestern DPS retained their Endangered status. At the same time FWS established a rule under § 4(d) of the ESA that applies to wolves listed as Threatened in the Western DPS (68 F.R. 15,804, 15,863).

USFWS can propose delisting of a species when it determines that a listed population has recovered and there are reasonable assurances that it will not be threatened again when ESA protections are removed (16 U.S.C. §1533(a)). Before USFWS can delist wolves in the NRM it must be determined that human-caused mortality can be regulated (68 FR 15,804 at 15,828) which requires state management plans for Montana, Idaho, and Wyoming that are consistent with the long-term conservation of wolves in the region (USFWS et al. 2003). USFWS must reevaluate the status of wolves by analyzing their status with reference to the five factors listed in § 4(a)(1) (16 U.S.C. §1533(a)(1)), including the "adequacy of existing regulatory mechanisms."

USDI Bureau of Land Management

The gray wolf does not appear on the Sensitive Species list maintained by the Wyoming State Office of the USDI Bureau of Land Management (BLM); this list explicitly excludes species already designated by the USFWS as Endangered or Threatened under ESA.

USDA Forest Service

Similar to the BLM, the USDA Forest Service (USFS) does not list the gray wolf on its Sensitive Species lists because of the taxon's overriding designation as Threatened under ESA.

State Wildlife Agencies

The Wyoming Game and Fish Department currently lists wolves as predatory animals in Wyoming, which means they can be taken any time of year without limit. However, because of their status under the ESA, wolves are not currently managed pursuant to Wyoming statute and regulations. Wolves in Wyoming are currently managed primarily by the USFWS, National Park Service (NPS), and United States Department of Agriculture Wildlife Services (Bangs et al. 2001).

If the wolf is delisted in the NRM Recovery Area, management authority will return to the states in which wolves reside if the states have enacted sufficient regulatory mechanisms as required for delisting (USFWS 1987).

Wyoming published a Final Management Plan (WGFD 2003) in preparation for satisfying the requirements of the NRM Recovery Plan for delisting. The Plan established a dual status for gray wolves in Wyoming of "trophy game animal" and "predatory animal" depending on the location of the pack or individual (WGFD 2003). If there are 15 packs in Wyoming (8 packs in YNP, Grand Teton National Park [GTNP] and John D. Rockefeller, Jr. Memorial Parkway, and 7 packs in the rest of Wyoming) then wolves would be trophy game animals within YNP and GTNP, the John D. Rockefeller, Jr. Memorial Parkway, and contiguous wilderness areas (Absaroka-Beartooth, North Absaroka, Washakie, Teton, Jedediah Smith, Winegar Hole, and Gros Ventre). Wolves located outside these areas would be classified as predatory animals (WGFD 2003). However, the delisting petition was rejected by USFWS in January 2004, primarily due to the assessment that the dual classification would not adequately protect wolves from once again becoming Threatened or Endangered. This issue remains unresolved at this time.

State Natural Heritage Programs

The gray wolf has been assigned the rank of **G4 / S1** by the Wyoming Natural Diversity Database (WYNDD; University of Wyoming), with a Wyoming Contribution rank of **High**. The **G4** indicates the species is relatively secure from extinction across its continental range; **S1** indicates a relatively high chance of extinction from the state of Wyoming. The **High** Wyoming

Contribution Rank indicates that Wyoming populations contribute highly to the continental persistence of the species.

Biological Conservation Issues

Human-caused mortality is consistently noted as the major problem that limits wolf distribution and abundance (Paquet and Carbyn 2003); specific causes include legal and illegal harvest, depredation control, and vehicle collisions. These are also the only sources of mortality that can significantly affect wolf populations at recovery levels (USFWS 2000). In the GYA, of 20 documented wolf mortalities in 2000, nine were human-caused (six control actions, two vehicle collisions, and one illegal take), six resulted from natural causes, and five were of unknown cause (USFWS et al. 2001). Researchers have found that if annual mortality exceeds 30-40%, wolf populations will generally decline (Ballard et al. 1987, Fuller 1989, Keith 1983). The response of wolves to humans is variable, as can be expected in a long-lived animal with complex social behavior. Wolves are sensitive to human predation and harassment, and loss of suitable wolf habitat is to be expected as human populations and developments increase.

In unexploited populations annual mortality is about 45% for yearlings and 10% for adults (USFWS 1994). Intraspecific conflict between neighboring packs, starvation, disease, and injury are the primary causes of mortality (Mech et al. 1998). However, natural mortality does not appear to regulate populations in the northern Rockies (USFWS 2000).

Flexible food habits, high annual productivity, and dispersal capabilities enable wolves to respond to natural and human-induced disturbances. These traits confer a high degree of resiliency on wolves (Weaver et al. 1996). Wolf distribution will ultimately be defined by the interaction of wolves' ecological requirements and human tolerance (Paquet et al. 2001), not by artificial delineations that are administratively determined. In short, the distribution and abundance of ungulates and humans define appropriate wolf habitat.

Gray wolves currently occur in disjunct populations in the conterminous United States, and management goals will be set to maintain this population structure. Computer simulations of the three disjunct wolf populations indicate that these populations can survive as long as there is at least occasional movement between populations, human persecution is not excessive, and prey is sufficiently abundant (Callaghan 2002, Haight et al. 1998). Furthermore, it is the long-term levels of mortality and immigration that are important, more so than the short-term fluctuations in dispersal and mortality. However, one ultimate factor that will determine whether wolves persist where they have been reintroduced, and where they disperse, is human attitudes towards wolf management. Of great importance is the ability of pro-wolf groups to tolerate lethal control of depredating animals. This will require a concerted effort on the part of federal and state agencies and of non-governmental groups. Other significant factors are stochastic events such as fire and weather extremes (especially as they affect ungulate populations), and disease. The GYA fires of 1988 removed much late seral conifer forest, which lead in part to a decline in local moose populations. The hard winter of 1996-1997 caused a decline in elk population, as has the current drought. Events like these are expected to reduce wolf carrying capacity, at least temporarily.

Disease can have surprisingly large effects on gray wolf populations. In the early 1980's the introduction of canine parvovirus into Isle Royale caused the wolf population to decline from 50 to 14 animals over two years (Smith et al. 2003).

<u>Abundance</u>

There are 50,000 wolves in Canada, and 6,000 to 8,000 in Alaska. There are 3,063 wolves in Michigan, Minnesota, and Wisconsin in the eastern distinct population segment; 664 wolves in the western distinct population segment; and 21 wolves in Arizona and New Mexico in the southwestern distinct population segment (USFWS et al. 2004). At the end of 2003 the USFWS estimated 301 wolves in the GYA, with about 235 residing within the state of Wyoming (USFWS et al. 2004).

Trends

Gray wolves have a higher reproductive capacity than other large predators, especially when game is plentiful and wolf density is low. This gives them the ability to rebound quickly when conditions are favorable. On the other hand, wolves are very visible and thus are susceptible to human-caused mortality. Also, their large area requirements tend to make them more vulnerable to environmental stochasticity and landscape fragmentation than is suggested by their vagility and potential fecundity (Carroll et al. 2003).

Abundance Trends

Wolves inhabited the GYA in relatively low numbers in the late 1800s. There was an apparent increase in parts of YNP around 1912, which triggered active control during 1914-1926. Wolves were virtually eliminated from Montana, Idaho, Wyoming, and southwest Canada by the 1930s. Although lone individuals were occasionally recorded in YNP through 1966, no packs formed or persisted in the region (USFWS 1987). In 1986, wolves from Canada raised a litter in Glacier National Park, and in 1995 active transplantation of wolves from Alberta to YNP occurred. Wolf recovery in the GYA progressed more quickly than anticipated (Bangs et al. 1998). Forty-one wolves were reintroduced between January 1995 and spring 1997 and by autumn of 1998, there were 116 wolves in the GYA. It is currently estimated that 301 wolves inhabit the region. Reproduction and survival rates were higher than expected over the past 9 years (Figure 4) (Bangs et al. 1998).

Population Extent and Connectivity Trends

An analysis of remaining unoccupied habitat in the northern Rocky Mountains found that large tracts of suitable habitat still remained (Oakleaf 2002, Oakleaf et al. in review). Central Idaho had the greatest amount of preferred wolf habitat (77,596 km^2), while the GYA and northern Montana had similar amounts (45,900 and 44,929 km^2, respectively). Adequate movement corridors exist between Idaho and Montana wolf populations, but the GYA population is poorly linked to the others via only narrow and somewhat fragmented corridors (Oakleaf 2002, Oakleaf et al. in review). Despite this conclusion, individuals have dispersed between all three subpopulations (M. Jimenez, personal communication).

A landscape modeling and population viability study of the Southern Rocky Mountains (primarily western Colorado) suggests a high potential for successful wolf restoration there (Carroll et al. 2003). If such restoration occurs, individuals may move between the GYA and Southern Rockies subpopulations via western and central Wyoming.

It is expected that wolf numbers will continue to increase in the GYA until all available habitat is occupied, although the intensity and timing of legal and illegal human-caused mortality will certainly affect their ultimate distribution and abundance (Oakleaf 2002, Oakleaf et al. in review).

Habitat Trends

Loss of suitable habitat, defined as areas with high densities of ungulates and low densities of people, is to be expected as human populations and developments increase in the Rocky Mountains. Because the relatively large base of public land in a wilderness or semi-wilderness state in the GYA will remain roughly unchanged into the foreseeable future, the trend in habitat loss will likely reduce but not eliminate wolves from the area.

Range Context

Historically, Wyoming formed part of the core of an almost ubiquitous gray wolf range. The state now sits on the southern periphery of occupied wolf range in North America. As one of the southernmost areas of occupation, northwestern Wyoming serves as a center from which historic range can be re-occupied throughout the Northern and Central Rocky Mountains and adjacent regions.

Extrinsic Threats and Reasons for Decline

Anthropogenic Impacts

In the coterminous U.S. the abundance and distribution of gray wolves is primarily determined by human-caused mortality, with the secondary influence of prey availability. Management of wolf populations outside of protected areas and where there are conflicts with other land uses, primarily livestock ranching, will almost certainly involve lethal control of wolves.

Invasive Species

There is no evidence of impacts of invasive species on wolves. There could be indirect impacts when noxious weeds replace native vegetation and reduce forage for ungulates, but no studies to date have addressed this issue.

Genetic Factors

Although wolves have interbred with coyotes and red wolves in other parts of the country, there is no evidence of such hybridization in Wyoming. Wolves in the Rocky Mountains show no introgression of coyote genes. It is generally assumed that hybridization will occur only under situations of extremely low wolf density, and that it will not occur to any meaningful degree in the GYA wolf population if it remains at or above recovery levels.

Natural Predation

Wolves are known to kill other wolves as they defend territories and attempt to assimilate into new packs, but natural predation does not pose a threat to the persistence of gray wolf populations.

Intrinsic Vulnerability

Habitat Specificity and Fidelity

Gray wolves can thrive in a variety of environmental settings and across rather broad gradients of climate, vegetation, and topography. In this sense they are habitat generalists. However, their distribution and abundance in the lower U.S. is strongly correlated with high densities of ungulates and low densities of humans. Given that areas of low human density are becoming increasingly rare in the Central Rocky Mountains (and also given that the density of ungulates varies in part with the density of humans), it might be argued that wolves are specialized to the degree that they prefer an unusual and uncommon environment. Gray wolves appear to be similar to wolverines and grizzly bears in this respect; their current distribution and habitat use is not an unrestricted reflection of the environments within which they can maximize survival and reproduction, but rather a reflection of where they can persist under limits currently imposed by people.

Territoriality and Area Requirements

Wolf packs require large areas, are highly territorial, and will repulse other wolves from their pack territory. A territory is the geographic area defended by a pack, which is difficult to measure. Pack home range is the entire area that the pack traverses, and can be readily assessed by documenting locations of radio-collared animals; these are the wolf-pack polygons shown by USFWS et al. (200, 2001, 2002, 2003, 2004) in their annual reports. Wolf home ranges for 56 wolf packs averaged 814 km^2 in the GYA, 1,296 km^2 in Idaho, and 599 km^2 in Montana (Oakleaf 2002, Oakleaf et al. in review). Territory and home range sizes are assumed to correlate with prey availability.

Susceptibility to Disease and Parasites

The effect of epizootics and enzootics on wolf population dynamics is not well documented. Where information is available, an estimated 2–21% of wolf mortality is due to disease. The transmission of disease from domestic dogs, e.g. parvovirus, is a grave conservation concern (Paquet and Carbyn 2003). Rabies is infrequent in wolf populations. Sarcoptic mange is an epizootic of concern, and some researchers suggest that it could be a regulating factor in canid populations. Other arthropod parasites are known but do not cause significant problems. Viral infections of concern are distemper and canine hepatitis. Canine distemper and canine infectious hepatitis are enzootic in wolf populations, and more recently canine parvovirus has also become enzootic in several wolf populations (Brand et al. 1995).

Dispersal Capability

Wolves are capable of very long-distance movements, and will move through a variety of landscapes and environments. In the Central Rocky Mountains, they have dispersed up to 800 km (Ballard et al. 1983, Boyd and Pletscher 1999). Recent reports of wolves dispersing from the GYA have placed them in habitats extending from desert-shrub and true grassland up through foothills and subalpine forest into alpine tundra.

Reproductive Capacity

Wolves have a rather high reproductive capacity, and can achieve high rates of annual population growth. Females are capable of breeding at two years of age, and have an average of five pups in a litter in Wyoming (USFWS et al. 2002), with a range of 1-11 (Mech 1974). They can reproduce every year of their lives. They typically live to less than 10 years, but can live as long as 16 years, and there can be more than one breeding female in a pack.

Sensitivity to Disturbance

Wolves have a relatively high tolerance for disturbance, and appear to habituate to disturbance events. They are probably most sensitive to general disturbance and harassment during the denning season, roughly April - August.

Protected Areas

Wolves are, and presumably will remain, completely protected in YNP, GTNP, and the National Elk Refuge. The 2003 Wyoming wolf management plan affords them the relatively protected status of trophy game animal in the John D. Rockefeller Parkway and most wilderness areas in northwestern Wyoming (Absaroka-Beartooth, North Absaroka, Washakie, Teton, Jedebiah Smith, Winegar Hole, and Gros Ventre). However, the same plan has been rejected by the USFWS primarily because it proposes wolves to be considered as unprotected predatory animals in the rest of the state. The resolution of this issue will largely determine the protected status of wolves in most of the state of Wyoming.

Population Viability Analyses (PVAs)

Recovery teams of U.S. federal agency biologists were the first to grapple with the question of a viable population size for gray wolves. Three subpopulations of at least 10 breeding pairs each, with movement of individuals between each subpopulation, was established as the minimum criteria for a viable population. Some calculations suggest that an effective population (N_e) size of 50 requires 46-150 wolves (USFWS 1994). However, there is still much discussion and controversy about minimum viable population size; some suggestions have ranged between 500 to several thousand individuals.

Conservation Action

The federal listing of the gray wolf in 1974 under the ESA was the initial action that ultimately led to reintroduction in the GYA in 1995. Federal and state managers are now negotiating the criteria necessary for recovery and de-listing; the primary issue is how the state of Wyoming, via the Wyoming Game and Fish Department, will manage wolves once de-listing has occurred.

Existing or Future Conservation Plans

As discussed, the de-listing of the gray wolf from the ESA will be determined largely by the result of ongoing negotiations between the state of Wyoming and the USFWS regarding the Wyoming Wolf Management Plan. The primary issue in need of resolution is how wolves will be classified by the state: as trophy game animals (subject to regulated and monitored harvest), predatory animals (subject to unregulated harvest), or some combination of the 2 classes.

Conservation Elements

Inventory and Monitoring

The USFWS is actively monitoring wolves in Wyoming, Idaho, and Montana via radio-collar telemetry and other techniques. Weekly updates of wolf locations are put on the website at http://westerngraywolf.fws.gov/index.htm . Once delisting occurs, USFWS will have a 5-year mandatory oversight of the monitoring conducted by the individual states.

Habitat Preservation and Restoration

To our knowledge there are no large-scale plans targeting habitat preservation and restoration for gray wolves in the region.

Augmentation and Reintroduction

To our knowledge there are currently no plans for further reintroductions or transplantations of gray wolves into the GYA region; the initial reintroduction effort has exceeded expectations in its success. There has been discussion of a reintroduction in the southern Rocky Mountains (Kindler 1994), and the state of Colorado initiated a process to develop a wolf management plan.

Information Needs

Rangewide Needs

Research on the coexistence of wolves, humans, and livestock industries will continue to inform the management of wolves rangewide and in Wyoming. Any information on specific livestock management techniques and environmental parameters that minimize conflict would be important. A better understanding of the viability of small wolf populations in wilderness, semi-wilderness, and human-dominated landscapes is needed, as well as spatial assessments of source-sink populations and connectivity (Paquet and Carbyn 2003). The degree to which wolves regulate populations of different prey species is still debated, and an area of meaningful research (Mech 1995b).

Three relatively new diseases have emerged in recent years that may have impacts on wolves: canine parvovirus, heartworm (*Dirofilaria immitis*), and Lyme disease. All three have been found in wolves, albeit in low numbers (Mech 1995b). Monitoring of disease in free-ranging wolf populations may be necessary to avoid or minimize potentially large outbreaks.

Wyoming Needs

All research discussed above is pertinent to the management of wolves in Wyoming. Computer geographic information systems (GIS) can express models of animal populations, movement, and habitat use in spatially-explicit form across detailed maps. In order to maximize their management value, research projects should be designed to produce GIS-compatible results so that resource managers can more effectively and efficiently apply recommendations in the field.

Tables and Figures

Table 1. Wolf (*Canis lupus*) packs and population data for Wyoming, 2002 (from USFWS et al. 2002, Table 2).

Table 2: Wyoming wolf packs and population data 2002.

	RECOV		PACK SIZE JAN 2002			MORTALITIES			KNOWN		CONTROL		CONFIRMED LOSSES[3]		
WOLF PACK[4]	AREA	STATE	ADULT	PUP	TOT	NATURAL	HUMAN[1]	UNKN	DISPERSED	MISSING[2]	KILLED	MOVED	CATTLE	SHEEP	DOGS
Druid Peak	GYA	WY	8	3	11				9	1					
Rose Creek II	GYA	WY/MT	7	3	10										
Tower	GYA	WY	2	0	2				1	2					
Leopold	GYA	WY	8	8	16	1			4						
Swan Lake	GYA	WY	5	11	16										
Mollie's	GYA	WY	10	2	12				2	1					
Chief Joseph	GYA	WY/MT	2	8	10	1	1		4	1					
Nez Perce	GYA	WY	15	3	20				3	1					
Cougar Creek	GYA	WY	5	5	10										
Yellowstone Delta	GYA	WY	10	4	14				1	1					
Agate Creek	GYA	WY	6	4	10										
Bechler	GYA	WY	2	2	4										
Geode Creek	GYA	WY	6	3	9	1									
Slough Creek	GYA	WY	4	0	4										
Loners inside YNP	GYA	WY	0	0	0	1									
Total in YNP	GYA	WY	90	56	148	4	1		24	7	0	0	0	0	0
Teton	GYA	WY	3	11	14				5	4			3		
Gros Ventre	GYA	WY	3	0	3										
Washakie	GYA	WY	10	5	15		3		3	2	3		5		
Sunlight Basin	GYA	WY	8	4	12		3				3		4		
Absaroka	GYA	WY	6	3	9		1								
Beartooth	GYA	WY	4	3	7										
Greybull River	GYA	WY	4	3	7										
Green River	GYA	WY	2	0	2										
Misc outside YNP	GYA	WY	0	0	0								11		
Total outside YNP	GYA	WY	38	29	69	0	7	0	8	6	6	0	23	0	0
WYOMING TOTAL	GYA	WY	128	85	217	4	8	0	32	13	6	0	23	0	0

1 Underlined packs are counted as breeding pairs toward recovery goals.
2 Includes 6 wolves killed in control actions.
3 Collared wolves that became missing in 2002
4 Another 4 calves were identified as probable wolf depredation.

Table 2. Confirmed wolf (*Canis lupus*) caused livestock losses in the Greater Yellowstone Area, from 1995 through November 2002 (USFWS et al. 2002 and WGFD 2003). Values in parentheses are the total number for the year in Wyoming.

	1995	1996	1997	1998	1999	2000	2001	2002	Total
Cattle	0	0	5	3	4 (1)	7 (3)	22 (20)	30 (25)	71 (49)
Sheep	0	13	67	7	13	39 (25)	117 (37)	36	292 (62)
Dogs	1	0	0	4	6 (4)	8 (5)	4 (4)	0	23 (13)
Horses	0	0	0	0	1 (1)	0	0	0	1 (1)
Wolves moved	6	8	14	0	0	6	8	?	42
Wolves killed	0	1	6	3	9	6	9	6	34

Figure 1. Current distribution of the gray wolf (*Canis lupus*) in North America. Note the presence of a small, reintroduced population in Arizona / New Mexico. Individual gray wolves are known to disperse widely outside of the shown range polygon. Historically, gray wolves occupied the entire map with the exceptions of the southeastern U.S. and areas south of central Mexico.

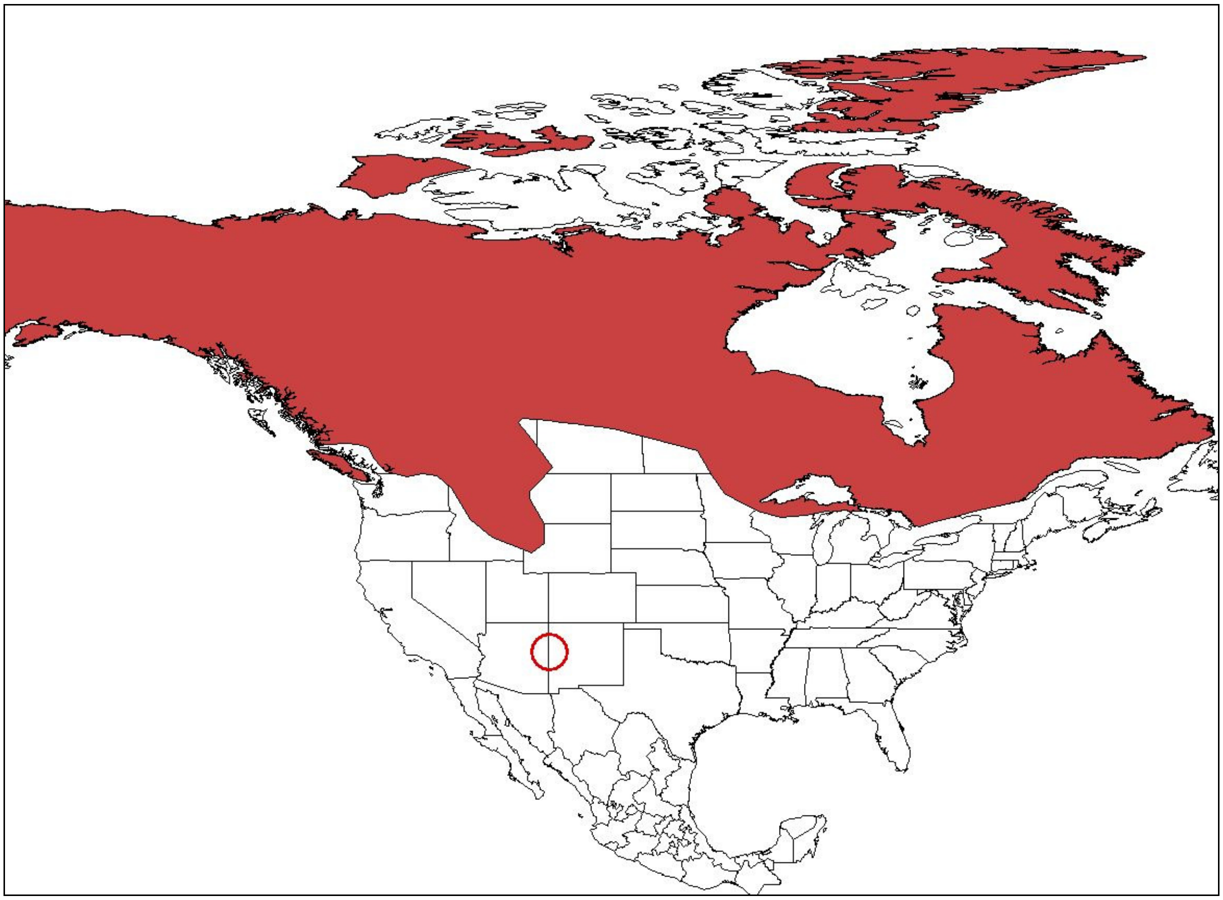


Figure 2. Wolf (*Canis lupus*) population size in Wyoming and the Greater Yellowstone Area, 1995-2001 (from WGFD 2003, Figure 3).

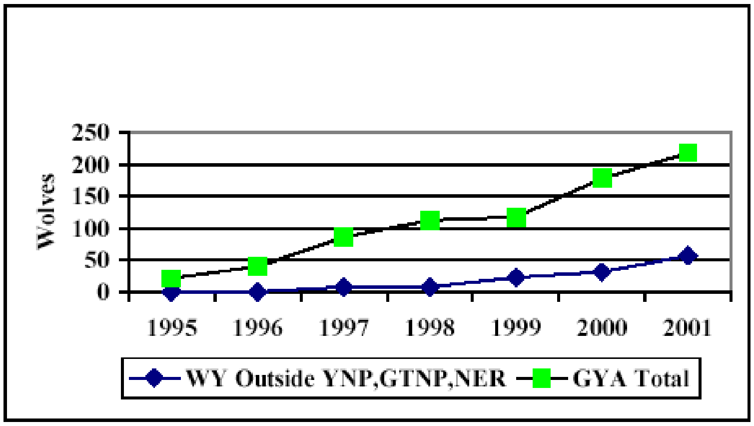
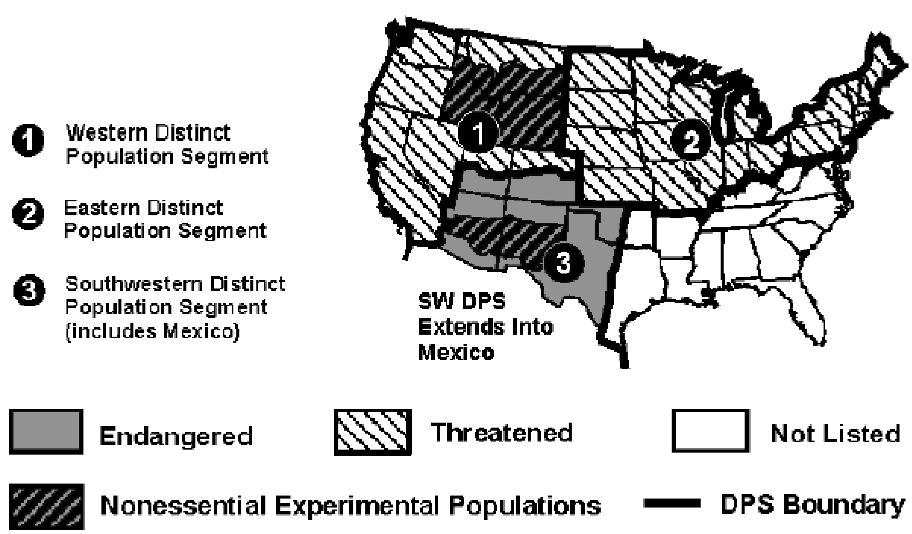


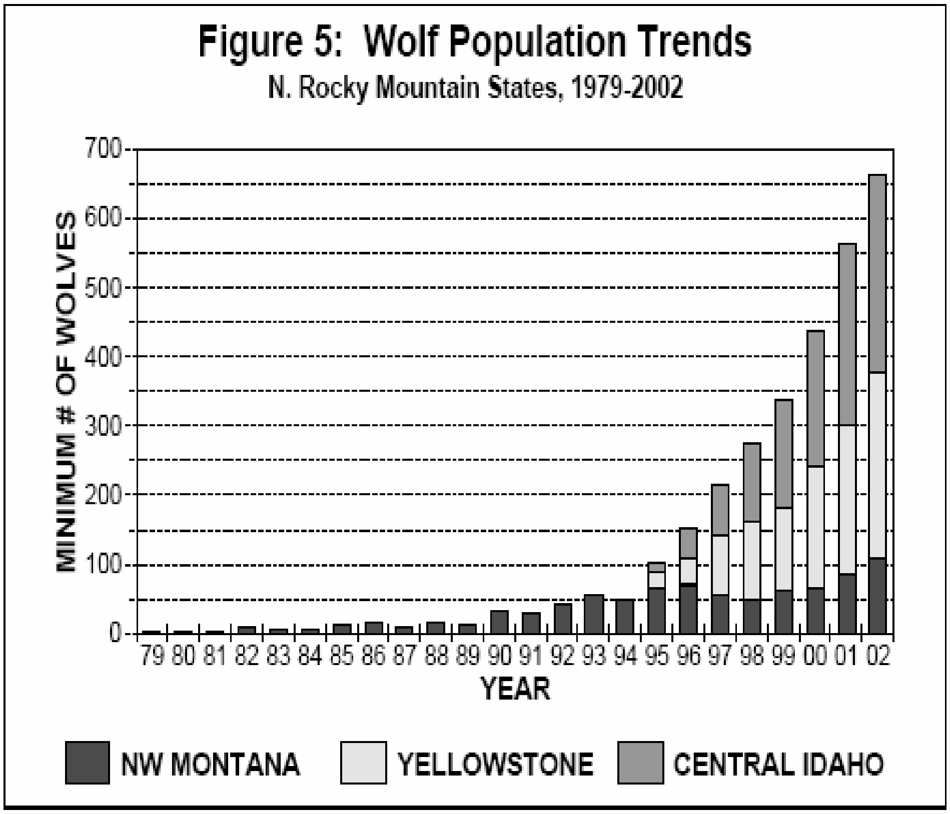
Figure 3. Wolf population size in Wyoming and Greater Yellowstone Area (GYA) 1995-2001. YNP=Yellowstone National Park, GTNP=Grand Teton National Park, NER=National Elk Refuge.

Figure 3. Distinct Population Segments of gray wolf (*Canis lupus*) in the lower 48 states (68 FR 15,804 at 15,862, 1 April 2003).



April 2003

Figure 4. Gary wolf (*Canis lupus*) population trends in the Northern Rocky Mountain Recovery Area (from USFWS et al. 2003).



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