A PETITION
TO PREPARE A RECOVERY PLAN & DESIGNATE CRITICAL HABITAT FOR THE GRAY WOLF (*Canis lupus*) IN THE SOUTHERN ROCKY MOUNTAINS

Black wolf in Yellowstone National Park (Mollie Pack). Courtesy of Ray Liable. Copyright 2007.

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I. EXECUTIVE SUMMARY

WildEarth Guardians hereby petitions the United States Fish and Wildlife Service (Service or FWS) to develop and implement a recovery plan for the gray wolf (*Canis lupus*) (wolf or wolves) in the Southern Rocky Mountains (or Southern Rockies) pursuant to the federal Endangered Species Act, 16 U.S.C. 1531 § *et seq*. (ESA), and Section 553 of the Administrative Procedure Act (APA), 5 U.S.C. 553. We further request designation of critical habitat for this species in the Southern Rockies, pursuant to provisions of the ESA, 16 U.S.C. § 1532(5)(B) and the APA, 5 U.S.C. § 553(e) and 50 C.F.R. § 424.14(d).

Gray wolves, the largest member of the canid family, once numbered in the hundreds of thousands across most of North America prior to and during early European settlement of the continent. Yet, by the mid-1940s, the species had been nearly completely extirpated from most of the lower forty-eight states. The last wild wolves in the Southern Rocky Mountains were eliminated by 1945. The ecological implications of eradicating wolves are now much better apprehended by science, and as explained in this petition, form the basis for the petitioner's pleadings.

Gray wolves are highly social animals, form packs in which (ordinarily) only the dominant or alpha male and female breed. Pack size, litter size and pack ranges can vary widely, and are functionally determined by prey abundance and behavior. Wolves prey on a variety of wildlife, but are primarily dependent on ungulates, such as caribou, elk, and deer. Healthy wolf populations can have dramatic beneficial effects on the ecology of a region. The reintroduction of wolves in the greater Yellowstone area, for example, has led to significant reductions in coyote populations, concomitant increases in pronghorn antelope, raptor, and small rodent populations, and improved riparian forest regeneration, thus helping increase songbird diversity and abundance.

Shortly after the passage of the ESA, the FWS listed as endangered four then-recognized subspecies of gray wolves: the eastern timber wolf (*C. l. lycaon*), the Northern Rocky Mountain wolf (*C. l. irremotus*), the Mexican gray wolf (*C. l. baileyi*), and the Texas gray wolf (*C. l. monstrabilis*). In 1978, in light of growing taxonomic uncertainty surrounding these classifications, FWS relisted the entire species, in the lower-48 states. Despite this change in listing status, however, the Service continued to manage gray wolves on a subspecies basis, thus leaving significant gaps in the range of the taxon. Moreover, the listed entity (wolves outside the Northern Rockies or Great Lakes) lacks a recovery plan(s), in violation of 16 U.S.C. 1531 § 1533(f).

Aiming to fill one of the aforementioned gaps in the occupied/recovered range of gray wolves, this petition invokes the mandates of the ESA for the full recovery of the gray wolf in the Southern Rockies. It then discusses why recovery planning for the species in the Southern Rocky Mountains is warranted and indicates areas for reintroduction of the species.

This petition also pleads for the concurrent designation of critical habitat for gray wolves in the Southern Rocky Mountains. Petitioners request that FWS consider for recovery planning and critical habitat designation purposes all habitat within the Southern Rocky Mountains that is currently suitable or that could be made suitable through mitigation of anthropogenic threats to the species. Petitioners expect that FWS will carry out its duties under the ESA and the APA in processing and acting upon this petition expeditiously in order to ensure the long-term conservation of the species.

II. PETITIONER

This petition is respectfully submitted by WildEarth Guardians. WildEarth Guardians protects and restores wildlife, wild rivers and wild places in the American West. Using a combination of litigation, scientific analysis, and grassroots organizing, WildEarth Guardians fiercely defends the West's wild heritage. WildEarth Guardians has approximately 4,500 members across the nation, many of whom live in or frequently visit the Southern Rocky Mountains for their recreational, scientific, and spiritual pursuits. WildEarth Guardians has been significantly involved in the effort to restore and protect wolves in the American West for over 15 years.

III. SPECIES DESCRIPTION

This petition calls for the development of a recovery plan and designation of critical habitat for gray wolves (*C. lupus*) in the Southern Rocky Mountains. Although the taxonomic and recovery history of the species and various subspecies within the range of the taxon in the lower forty-eight states is complex, this petition takes no position on the appropriateness of any particular subspecies of *Canis lupus* for the Southern Rocky Mountains, but rather acknowledges that the region was historically occupied by *C. l. nubilus* (Nowak 1995), and that the southern portion of the ecoregion likely represented a "zone of gradation" between *C. l. nubilus* and the Mexican wolf *C. lupus baleyii* (Phillips et al. 2000). Therefore, the species description (and the petition focus) herein remains grounded at the species level (i.e. *C. lupus*).

Gray wolves are the largest wild members of the dog family (*Canidae*). Adult gray wolves range from 18–80 kilograms (kg) (40–175 pounds (lb)) depending upon sex and region (Mech 1974, p. 1). In the NRM, adult male gray wolves average over 45 kg (100 lb), but may weigh up to 60 kg (130 lb). Females weigh slightly less than males. Wolves' fur color is frequently a grizzled gray, but it can vary from pure white to coal black (Gipson et al. 2002, p. 821). Gray wolves have a circumpolar range including North America, Europe, and Asia. As Europeans began settling the U.S., they poisoned, trapped, and shot wolves, causing this once widespread species to be eradicated from most of its range in the 48 conterminous States (Mech 1970, pp. 31–34; McIntyre 1995).

Gray wolf populations were eliminated from Montana, Idaho, and Wyoming, as well as adjacent southwestern Canada by the 1930s (Young and Goldman 1944, p. 414). Wolves primarily prey on medium and large mammals. Wolves normally live in packs of 2 to 12 animals. In the NRM, pack sizes average about 10 wolves in protected areas, but a few complex packs have been substantially bigger in some areas of Yellowstone National Park (YNP) (Smith et al. 2006, p. 243; Service et al. 2007, Tables 1–3).

Packs typically occupy large distinct territories from 518 to 1,295 square kilometers (km2) (200 to 500 square miles (mi2)) and defend these areas from other wolves or packs. Once a given area is occupied by resident wolf packs, it becomes saturated, and wolf numbers become regulated by the amount of available prey, intra-species conflict, other forms of mortality, and dispersal. Dispersing wolves may cover large areas as they try to join other packs or attempt to form their own pack in unoccupied habitat (Mech and Boitani 2003, p. 11–17).

Typically, only the top-ranking ("alpha") male and female in each pack breed and produce pups (Packard 2003, p. 38; Smith et al. 2006, pp. 243–4; Service et al. 2007, Tables 1–3). Females and males typically begin breeding as 2-year-olds and may annually produce young until they are over 10 years old. Litters are typically born in April and range from 1 to 11 pups, but average around 5 pups (Service et al. 1989–2007, Tables 1–3). Most years, four of these five pups survive until winter (Service et al. 1989–2007, Tables 1–3).

Wolves can live 13 years (Holyan et al. 2005, p. 446), but the average lifespan in the NRM is less than 4 years (Smith et al. 2006, p. 245). Pup production and survival can increase when wolf density is lower and food availability per wolf increases (Fuller et al. 2003, p. 186).

Pack social structure is very adaptable and resilient. Breeding members can be quickly replaced either from within or outside the pack and pups can be reared by another pack member should their parents die (Packard 2003, p. 38; Brainerd et al. 2008; Mech 2006, p. 1482). Consequently, wolf populations can rapidly recover from severe disruptions, such as very high levels of human-caused mortality or disease.

After severe declines, wolf populations can more than double in just 2 years if mortality is reduced; increases of nearly 100 percent per year have been documented in low-density suitable habitat (Fuller et al. 2003, pp. 181–183; Service et al. 2007, Table 4).

RECOVERY HISTORY & BACKGROUND

Gray wolves were first listed as an endangered species in 1967. Shortly after passage of the ESA in 1973, the FWS initiated federal efforts to recover wolves. The first list of endangered species included the eastern timber wolf (*C. l. lycaon*), and the northern Rocky Mountain wolf (*C. l. irremotus*) (U.S. Fish and Wildlife Service 1974). In April 1976, the Mexican wolf (*C. l. baileyi*) was listed as endangered (*Federal Register* 41:17740). In June 1976, the Texas wolf (*C. l. monstrabilis*) was listed as endangered (*Federal Register* 41:24064). At the time, gray wolves were only represented by a remnant population in northeastern Minnesota and a few animals on Isle Royale National Park.

In 1978, recognizing a trend among taxonomists to recognize fewer subspecies of wolves, the FWS combined the subspecific listings for the gray wolf and reclassified it at the species level as endangered throughout the conterminous United States and Mexico, except for Minnesota where the gray wolf was reclassified to threatened (Nowak 1978). As the FWS finalized this reclassification, some voiced concern that eliminating subspecific differentiation could jeopardize efforts to locate and maintain subspecific stocks.

In response, the FWS indicated that efforts would continue to recognize valid subspecies for purposes of research and conservation (Nowak 1978). Shortly after the listing action was completed, the FWS formed recovery teams that were charged with developing and implementing plans for recovering wolves. Those teams then developed three plans that cover three separate geographic areas within the range of the taxon: the Great Lakes, the northern Rockies, and the southwestern U.S. (for the Mexican Wolf). Presently, there is no range-wide recovery goal for wolves, and no region-specific recovery goal for wolves in the Southern Rockies (thus, the submission of this petition).

The Gray Wolf in the Great Lakes Region

The gray wolf recovery plan was written for the Great Lakes region and approved by the FWS in May 1978 (U.S. Fish and Wildlife Service 1978). The recovery plan for the Great Lakes does not include goals or criteria for the wolf population on Isle Royale because it is not considered an important factor in the long-term survival of the species. The population on the island is small (i.e., usually includes 12 to 25 animals and has never included more 50 wolves) and almost completely isolated from other wolf populations (Peterson et al. 1998). While assigning no "recovery value" to the Isle Royale population, the FWS does recognize the population's importance as the focus of long-term research and has recommended that it be completely protected (U.S. Fish and Wildlife Service 1992).

A revised plan, approved in January 1992 (U.S. Fish and Wildlife Service 1992), included two delisting criteria. The FWS considered wolves in the Great Lakes region as a single population that would be recovered once the survival of the Minnesota population was secure and an additional viable population lived outside of Minnesota. These criteria have been met since the year 2001, and the FWS announced that the Great Lakes Distinct Population (DPS)[1] segment was de-listed in March of 2007—thereafter managed by the states (2007 *Federal Register* 72: 6052-6103). There are now nearly 4,000 wolves in Minnesota, Wisconsin, and Michigan—the Great Lakes region (2007 *Federal Register* Vol. 72: 6051- 6103).

Prior to passing the ESA, wolves in Minnesota were not protected and could be hunted and trapped. Additionally, the State sponsored a control program that included aerial gunning and bounty payments. Aerial gunning ended in 1956 and bounty payments ended in 1965 (Minnesota Department of Natural Resources 2001). From that time until 1973, some wolves were killed for fur, while others were killed under the state's predator control program. Various surveys conducted from the late 1950s to 1973 indicated that the Minnesota wolf population did not exceed 1,000 animals and dropped as low as 350-700 individuals.

After wolves were included on the list of threatened and endangered species, the population in Minnesota began to grow and expand into Wisconsin and Michigan. Historically, Wisconsin held about 3,000 to 5,000 wolves, but from about 1830 to 1960 that number dropped to zero (Thiel 1993, Wydeven et al. 1995). Until the mid-1970s, occasional sightings were reported, but there was no evidence of reproduction (Wisconsin Department of Natural Resources 1999). By the mid-1980s, the wolf population numbered 15 to 25 animals (Wydeven et al. 1995). By 1997, the Wisconsin wolf population had exceeded the state's endangered criteria and its status was changed to threatened (i.e., 80 or more wolves for 3 successive years).

In Michigan, the last known breeding population of wolves (outside of Isle Royale) was reported in the mid-1950s. While numbers continued to decline through the 1970s, it is possible that wolves were never completely extirpated from the state (Michigan Department of Natural Resources 1997). During the 1980s, reports of wolves in the Upper Peninsula increased, and a pair produced pups there in 1991.

In 1997, the Michigan Department of Natural Resources finalized a comprehensive management plan for Michigan's wolf population. In 1999 and 2001, Wisconsin's and Minnesota's Departments of Natural Resources did the same (respectively). Those three state plans should ensure the long-term survival of wolves in the Great Lakes region.

By 2001, the wolf population in Minnesota included > 2,500 animals distributed over about 40% of the state, Wisconsin's wolves numbered 251 animals distributed over about 40% of Wisconsin, and Michigan had 249 animals distributed over about 30% of the State. As of 2006, the population in Minnesota contained 3,020 wolves, Wisconsin had 465 wolves, and Michigan had 434—not counting Isle Royale's 30 wolves (2007 *Federal Register* Vol. 72: 6051- 6103).

The Gray Wolf in the Northern Rocky Mountains

In 1974, the FWS started an interagency wolf recovery team, which then completed the

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[1] In 1996 the FWS and the National Marine Fisheries Service adopted a policy for recognizing DPS for purposes of listing, reclassifying, and delisting vertebrate species (Fay and Nammach 1996). This policy may allow the Service to protect and conserve species and the ecosystems upon which they depend before large-scale declines occur that would necessitate listing a species or subspecies throughout its entire range. For a group of vertebrates to be recognized as a DPS they must be "discrete" and "significant." Discreteness requires that the population segment be delimited by physical, physiological, ecological, or behavioral barriers or by an international boundary that coincides with differences in the degree of protection. Significance requires that the population segment inhabit an unusual or unique ecological setting, exhibit marked genetic differences from other populations of the parent taxon, or inhabit an area that, if devoid of the species would result in a significant gap in the range of the taxon.

Northern Rocky Mountain Wolf Recovery Plan (U.S. Fish and Wildlife Service 1980). A revised plan focused recovery on northwestern Wyoming, western Montana, and central Idaho (U.S. Fish and Wildlife Service 1987). These areas are characterized by large tracts of public land, healthy populations of native ungulates, and relatively few livestock. The 1987 plan identified several criteria for down-listing and delisting the species and predicted that about 300 wolves in 30 packs would inhabit the region at the time of recovery. The plan promoted natural recovery for Montana and Idaho, if two packs had become established in Idaho by 1992. If two packs did not exist in Idaho by 1992, then reintroduction would become a tool for Idaho and YNP. The Plan recognized that the most certain way to restore wolves to the Greater Yellowstone Ecosystem was by reintroduction.

During the 1960s, the stage was set for wolves to naturally recolonize northwestern Montana as the Canadian government greatly reduced human-caused mortality in southwestern Canada (Carbyn 1983). By the 1970s, dispersing wolves were traveling through northwestern Montana, and by 1982 a pack inhabited Glacier National Park (Ream and Mattson 1982). In 1986, the first litter of pups in over 50 years was born there (Ream et al. 1985, Ream et al. 1989). By 1993, the number of wolves in northwestern Montana had increased to 55 (Fritts et al. 1995). By December 2001 the population included 84 wolves (U.S. Fish and Wildlife Service et al. 2002). By 2003 there were 183 wolves and the population essentially stopped growing; by 2006 there were 159 individuals in Montana (2007 *Federal Register* Vol. 72: 6106- 6139). Northwestern Montana has lower ungulate densities and higher levels of livestock than the other two areas of the Northern Rockies Area (Idaho and Yellowstone), thus wolves may be closer to their carrying capacity—particularly the capacity of human tolerance (Bangs et al. 2001).

By the early 1990s, two naturally occurring packs had not materialized in Idaho, and interest in restoring wolves to YNP had intensified. While Leopold (1944) had first discussed wolf restoration to the Park in the 1940s, it was not until 1972 that the Department of Interior officially considered the idea. That stimulated a study to determine if any wolves remained in Yellowstone; infrequent sightings were still being reported to Park officials. The study concluded that wolves were absent from the Park and recommended that the species be restored through reintroductions (Weaver 1978).

In 1989, Congressman Wayne Owens (D-UT) introduced a bill in the U.S Congress that required the FWS to prepare an Environmental Impact Statement (EIS) on wolf reintroduction to Yellowstone Park. The bill prompted numerous discussions, but it did not authorize an EIS. Congress did, however, fund two reports aimed at answering the many questions surrounding wolf restoration (Yellowstone National Park et al. 1990, Varley and Brewster 1992). In 1992, Congress directed the FWS to prepare an EIS on wolf reintroduction to Yellowstone and central Idaho.

Authorization initiated what would become one of the most extensive public processes ever conducted for a national environmental issue. The EIS took 2½ years to complete and covered all aspects of reintroducing wolves to Yellowstone and central Idaho. After releasing the draft EIS, government officials held more than 130 public hearings and meetings, and considered 160,000 public comments from all fifty states and forty foreign countries (U.S. Fish and Wildlife 1994). The final EIS was published in April 1994, and by July 1994 the Secretaries of the Interior and Agriculture had signed a "Record of Decision and Statement of Findings on the Environmental Impact Statement" effecting the final EIS as the federal government's official policy.

The final EIS recommended reintroducing about 15 wolves annually to both Yellowstone and Idaho. This would continue for three to five years, and the wolves would come from Canada. It also recommended that released wolves and their offspring be designated as members of experimental-nonessential populations per section 10(j) of the ESA (Bangs 1994). Such a designation allows the FWS to relax the restrictions of the ESA when managing wolves (Parker and Phillips 1991, Bangs 1994).

The restoration plan called for releasing wolves in Idaho immediately after being moved from Canada (i.e., a "hard" release), whereas in Yellowstone the wolves would be acclimated for several weeks in large pens at the site of release before being set free (i.e., a more labor-intensive, "soft" release). Because hard releases are most easily conducted, they have been commonly used to reintroduce wildlife throughout North America (Griffith et al. 1989). While the overarching objective was to establish populations of wolves in the Greater Yellowstone Area and central Idaho as quickly and cost-effectively as possible, the FWS did decide to test the two approaches (hard releases versus soft releases) to refine and optimize subsequent releases and to gain information to benefit future wolf reintroductions (Fritts et al. 1997).

In January 1995, 15 wolves from Alberta, Canada were released in Idaho. In January 1996, 20 wolves from British Columbia, Canada were released in Idaho (Bangs and Fritts 1996, Fritts et al. 1997). In March of 1995, the FWS approved a Nez Perce Tribe wolf management plan, but that plan applied only to listed wolves (*Federal Register*: February 27, 2008 (Volume 73, Number 39)). The overall goal of the plan was to establish a wolf population in central Idaho that will contribute to the recovery of the species in the northern Rocky Mountains.

During March 1995, 14 wolves from Alberta were released in YNP. In January 1996, 17 wolves from British Columbia were released in Yellowstone (Phillips and Smith 1996). Furthermore, due to a wolf control action in northwestern Montana, 10 pups were placed in an acclimation pen in the Park in late 1996. These wolves were under the jurisdiction of the National Park Service and the FWS.

Both wolf opponents and proponents filed several lawsuits over the experimental-nonessential designation for reintroduced wolves. Wolf proponents claimed that the designation illegally reduced protection of the ESA for naturally occurring wolves inhabiting northwestern Montana and possibly central Idaho. In December 1997, wolf opponents won the day when a Wyoming federal judge in the U.S. District Court of Wyoming determined that the designation had been illegally applied and ordered the FWS to remove the already reintroduced wolves and their offspring. Given the ramifications of his determination, the order was stayed pending appeal. The appeal was settled in January 2000 as the 10th Circuit Court of Appeals (Denver, Colorado) reversed the Wyoming court order. The losing parties did not appeal to the United States Supreme Court.

The reintroduced wolves adapted better than predicted. Only two years of reintroductions were required to ensure population establishment rather than three to five years of reintroductions as predicted (Fritts et al. 1997). Compared to predictions in the EIS, the wolves have produced more pups, survived at a higher rate, and caused fewer conflicts with humans[2] (Phillips and Smith 1996, Bangs et al. 1998, Smith et al. 1999, Fritts et al. 2001). Additionally, by 2001 over 70,000 visitors to Yellowstone have observed wolves (National Park Service unpublished data) and public interest in recovery remains high.

Both hard and soft-release techniques established wolf populations. Fritts et al. (2001) concluded:

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[2] The frequency of wolf control belies the actual magnitude of the wolf-livestock problem. For example, only about 1% of farms in wolf range in Minnesota suffer verified wolf depredations (W. J. Paul, unpublished report, 1998 as cited by Mech et al. 2000). Similarly, in the northern Rockies average annual confirmed losses have been slight: 4 cattle and 28 sheep 9 (and 4 dogs) in the Greater Yellowstone Area and 9 cattle and 29 sheep (and 2 dogs) in Idaho. These rates are one-third to one-half of the rates predicted in the Environmental Impact Statement. In contrast livestock producers in Montana annually report losing about 80,000 cattle and 90,000 sheep (Bangs 1998). Financial compensation for livestock losses has proven useful for minimizing animosity toward wolves (Fischer 1989, Fischer et al. 1994).

> "It appears that if landscape conditions, prey availability, wolf restoration stock, and early release management are suitable … the choice of hard versus soft release seems to matter little. Nonetheless, hard releases may be advantageous if the size of the area can accommodate wolves wandering without encountering people or killing livestock. The technique is relatively inexpensive as well, and involves less husbandry. If the size of the area is restricted, however, then a soft release should be used to limit post-release movements. Because few areas are as extensive as central Idaho, soft releases are likely to be preferred in future wolf restoration efforts."

The above summary of the Yellowstone project is complemented well by several books that provide additional details, including Fischer (1995), Ferguson (1996), Phillips and Smith (1996), Schullery (1996), McNamee (1997), and Smith and Ferguson (2005).

From the original 31 Canadian wolves of 1995 and 1996 (plus the 10 pups from northwestern Montana in 1996), the wolf population inhabiting the Greater Yellowstone Area grew to 189 individual wolves by December of 2001; by 2006, the number in the Greater Yellowstone Area was 371 (2007 *Federal Register* Vol. 72: 6106- 6139). Under the guidance of the Nez Perce Tribe, there were 251 wolves in Idaho by the end of 2001 and 713 by 2006 (2007 *Federal Register* (Volume 72: 6106- 6139)). With the 159 wolves in northwestern Montana, that meant there were 1,243 wolves in the Northern Rockies Area.

The recovery goal set in 1987 10 or more breeding pairs in each of the three recovery areas for three consecutive years, giving a total of more than 300 individual wolves throughout the region (Refsnider 2000:43454, 43457). By 1999, the FWS indicated that they might change the objectives for recovery. This was likely due to ceaseless political controversy, early rapid growth of wolf populations in the Greater Yellowstone Area and central Idaho, and the relatively slow growth of the wolf population in Montana. The new objective for recovery came from Appendix 9 of the EIS for the reintroductions (U.S. Fish & Wildlife Service 1994:6-75). It stated:

> "Thirty or more breeding pairs comprising some 300+ wolves in a metapopulation with genetic exchange between sub-populations should have a long-term probability of persistence."

In November 2001, the FWS queried dozens of professionals familiar with wolf recovery on the topic of population viability. By February 2002 (Bangs 2002), the FWS had determined that the official recovery goal for the Northern Rockies would be maintenance of a viable wolf population for three consecutive years. A viable population was defined as:

> "Thirty or more breeding pairs (an adult male and an adult female wolf that have produced at least 2 pups that survived until December 31 of the year of their birth, during the previous breeding season), comprising some 300+ wolves in a metapopulation with genetic exchange between sub-populations."

The population of wolves no longer had to be distributed equally. This recovery objective was reached in December 31, 2002. The FWS then proposed that the gray wolf in the Northern Rocky Mountains DPS be removed from the list of threatened and endangered species. Besides the Greater Yellowstone Ecosystem, northwestern Montana, and central Idaho (areas having wolves), this DPS includes the eastern parts of Washington and Oregon, north-central Utah, and the rest of Montana, Idaho, and Wyoming—areas of former range where wolves no longer exist (2007 *Federal Register* Vol. 72: 6106- 6139).

One hurdle remained. Wolves could not be delisted in the Northern Rockies DPS until

Wyoming, Idaho, and Montana each submitted management plans assuring that adequate regulatory mechanisms existed to protect wolves at or above recovery level after federal protection was removed; the plans had to be approved by the FWS (2007 *Federal Register* Vol. 72: 6106- 6139). There is no point in removing federal protection from a threatened or endangered species if the subsequent local management will then mismanage the species to the point where it is again threatened.

In January 2002, the Montana Fish, Wildlife, and Parks department released a conservation and management plan which was accepted by the FWS. In March 2002, the Idaho Legislative Wolf Oversight Committee finalized a wolf conservation and management plan (Idaho Legislative Wolf Oversight Committee 2002). This plan was developed and approved by the state legislature and the FWS. After delisting, the Nez Perce Tribe will give management responsibilities to the Idaho Game and Fish Department. Because of Tribe's expertise, the Idaho Department of Game and Fish intends to consult with the Tribe when the state assumes management authority.

Even though the 2002 legislature in Idaho approved a wolf management plan that was acceptable to the FWS, the 2001 legislature had previously passed House Joint Memorial No. 5 which "not only calls for, but demands, that wolf recovery efforts in Idaho be discontinued immediately and wolves be removed by whatever means necessary." As indicated in the final management plan, House Joint Memorial No. 5 continues to be the official position of the state of Idaho. The official position notwithstanding, Memorial No. 5 does not carry the weight of law. Nevertheless, Idaho governor Butch Otter spoke at "Idaho Sportsman's Day" on 11 January of 2007, and he vowed to kill more than 80 percent of Idaho's wolves, perhaps shooting the first one himself; he promised to begin the moment wolves are removed from the federal endangered species list (Woodruff 2007).

Wyoming did not complete a wolf management plan until 2004, and that plan was rejected by the FWS as inadequate to maintain wolves at a recovery level (2007 *Federal Register* Vol. 72: 6106-6139). Wyoming litigated this decision in the Wyoming Federal District Court, but the case was dismissed on procedural grounds. *Id*. Wyoming appealed, but in April of 2006 the Tenth District Court of Appeals (in Denver, Colorado) agreed with the Wyoming District Court. Thus, on August 1, 2006, the FWS determined that wolves of the Northern Rockies Area could not be delisted because Wyoming did not provide the necessary regulatory mechanisms to conserve their share of the wolf population (2006 *Federal Register* Vol. 71: 43410). In short, Wyoming would declare the wolf a predatory animal outside of the northwestern section of the state, meaning they could be shot on sight, and the FWS thought that was a threat to the species (Smith and Ferguson 2005).

The FWS delisted gray wolves in the Northern Rocky Mountains in February of 2008 (*Federal Register* Vol. 73, Number 39), however litigation had, at the time of filing <u>this</u> petition, forced the FWS to voluntarily rescind the delisting final rule. As such, wolves in the Northern Rocky Mountains will remain endangered, except where designated as a experimental non-essential population.

The Mexican Gray Wolf in the Southwest

The Mexican wolf was extirpated from the southwestern U.S. by the 1940s. Between 1977 and 1980, under an agreement between the United States and Mexico, five Mexican wolves were captured in the Mexican states of Durango and Chihuahua. These four males and one pregnant female were transported to the Arizona-Sonora Desert Museum to establish a captive breeding program. In 1979, the Service formed a Mexican Wolf Recovery Team. That team finalized a binational recovery plan with Mexico in 1982 (U.S. Fish and Wildlife Service 1982). The prime objective of the plan was to maintain a captive breeding program and to reestablish a population of at least 100 Mexican wolves within their historic range (U.S. Fish and Wildlife Service 1982). The plan called for the re-establishment of at least two wild populations, but did not specify a population goal for the second one. The recovery team considered the prime objective to be a necessary action for "conserving and ensuring the survival of the Mexican wolf," but did not propose a numerical objective for full recovery and delisting (from the ESA) of the Mexican wolf.

Given the absence of wild Mexican wolves, captive breeding is essential to recovery. In the mid-1990s two captive lineages of Mexican wolves were found to be of pure wild strains and were included in the captive breeding program. This increased the number of founders of the captive-bred population to seven. Thus, all known Mexican wolves in existence today stem from these seven founders—a true brush with extinction. By the end of 2006, the captive breeding program included about 291 animals maintained at 33 facilities in the United States and 15 facilities in Mexico. Management of this program is guided by a Species Survival Plan (SSP) developed and implemented by the American Zoo and Aquarium Association (Siminski and Spevak 2006). A goal is to keep at least 240 wolves in captivity to protect the species in the captive reservoir, while producing additional animals for reintroduction (www.fws.gov/southwest/es/mexicanwolf).

Wolves at three U.S. facilities are bred and managed for reintroduction: The Sevilleta National Wildlife Refuge and Ladder Ranch (owned by Ted Turner) wolf management facilities, both in New Mexico, and Wolf Haven International in Tenino, Washington. Wolves with potential for reintroduction are managed with minimal human contact. That promotes behavior to avoid humans and maximizes pair bonding, breeding, pup rearing, and pack formation. Wolves are selected for reintroduction by genetic makeup, reproductive performance, behavior, and physical prowess (www.fws.gov/southwest/es/mexicanwolf).

During the early 1990s, with the species becoming increasingly secure in captivity, the FWS began developing an EIS for reestablishing a wild population. After considering nearly 18,000 comments on the draft EIS, the Service recommended reintroducing Mexican gray wolves to the Blue Range Wolf Recovery Area (U.S. Fish and Wildlife Service 1996). The Record of Decision was signed in March 1997, and the specifics for reintroduction and management were published shortly thereafter (*Federal Register* April 3, 1997 (Volume 62, Number 64); Parsons 1998). Similarly, the Arizona Game and Fish Department (AGFD) concluded that the Arizona portion of the Blue Range Wolf Recovery Area was best suited for a reintroduction project (Johnson et al. 1992). In 1995, the AGFD developed a cooperative reintroduction plan for this area (Groebner et al. 1995).

The Blue Range Wolf Recovery Area encompasses 17,752 km^2 (6,854 mi^2) of the Gila National Forest in New Mexico and the Apache National Forest in Arizona and New Mexico. The final rule (*Federal Register* April 3, 1997 (Volume 62, Number 64); Parsons 1998) authorizes the Service to reintroduce wolves only in the "primary recovery zone" of the Blue Range Wolf Recovery Area, an area that encompasses about 2,664 km^2 (1,091 mi^2) of the Apache National Forest. The remainder of the Blue Range Wolf Recovery Area comprises the "secondary recovery zone." The Service is authorized to only conduct re-releases in the secondary recovery zone. Wolves that travel from the primary recovery zone can inhabit the secondary zone. Wolves that live entirely outside the boundaries of the Blue Range Wolf Recovery Area are required to be captured and brought back or returned to captivity (www.fws.gov/southwest/es/mexicanwolf). This is the only endangered species reintroduction project where hard boundaries legally limit the area that can be occupied by the species in the wild, even though suitable areas exist on public lands outside the boundary.

At the beginning of the project, the New Mexico Game Commission officially opposed the Blue

Range Wolf Recovery Area project. On March 29, 2002 the Game Commission unanimously reaffirmed its opposition to the reintroduction of wolves in the Gila National Forest portion of the Blue Range Wolf Recovery Area. Citing a study by the NM Game and Fish Department, the Commission claimed that no potential wolf release sites in the Gila National Forest would provide the biological and societal characteristics necessary for success. A new Game Commission appointed by incoming Governor Bill Richardson reversed the position to one of support for wolf reintroduction and recovery in the state at its meeting on April 4, 2004. Early opposition to the Blue Range Wolf Recovery Area project notwithstanding, the New Mexico Game and Fish Department (NMGFD) has provided a field biologist to serve on the Interagency Field Team since 1999, and is now one of six co-leading agencies. In addition, the White Mountain Apache and San Carlos Apache Tribes initially showed little interest in the reintroduction, but the White Mountain Apache became a member of the six co-leading agencies in 2002, and began allowing wolves to occupy Tribal lands in 2003.

In contrast, the Arizona Game Commission has never opposed the Blue Range reintroduction project; and the AGFD has actively acquired lead roles in the management of the wild population and in the management decision-making process. The AGFD promoted the 2003 memorandum of understanding which formed the multi-agency Adaptive Management Oversight Committee, which it leads. The AGFD has a much larger budget (from lottery proceeds) than does the NMDGF.

The FWS's reintroduction plan called for releasing about 15 wolves every year for up to five consecutive years, beginning in 1998 (Parsons 1998). The plan also called for designating reintroduced wolves and their offspring as members of an experimental-nonessential population (Parsons 1998). Ninety-one Mexican wolves were released from 1998 through 2006—four years beyond the anticipated need to release wolves. Additional future releases may be necessary. The Adaptive Management Oversight Committee has implemented standard operating procedures for addressing livestock-wolf conflicts and other concerns of local people. The Service estimated that it would take nine years (1998-2006) to reach a population of 100 wolves with 18 breeding pairs (U.S. Fish and Wildlife Service 1996). According to official project updates at the nine-year mark, the population was estimated to be 49-59 wolves and 7 breeding pairs (6 breeding pairs under a strict application of the definition). As of the end of February 2007, additional lethal control has eliminated the alpha male of one of these breeding pairs. Two lawsuits filed by primarily livestock interests to stop the Mexican wolf reintroduction project did not prevail.

The population of Mexican wolves has not grown as fast as did the populations in other regions. The prediction of 100 wolves and 18 breeding pairs after nine years (2006) has not been met. Average litter size is 2.1, compared to 4.2-6.9 elsewhere (Fuller, et al. 2003), and the average pack size is 4.8 (www.fws.gov/southwest/es/mexicanwolf). A telling finding in the five-year review from 1998-2003 (http://www.fws.gov/southwest/es/mexicanwolf/MWNR_FYRD.shtml) was an average annual failure rate of 64 percent. Failure rate is the sum of wolf mortalities plus wolves killed or removed from the wild by deliberate management actions carried out by the agencies (e.g., because a wolf preyed on livestock three times). Such a high failure rate is unsustainable without continued supplementation of the population through releases, especially given the lower than average litter sizes. This explains the continuation of releases beyond what was initially anticipated.

Most mortality of Mexican wolves has been human-caused. From 1998 through February 2007 there have been 23 illegal shootings, 10 killed by vehicles, 9 lethally controlled by the agencies, 13 that died directly or indirectly from capture complications, and 12 that died from natural or unknown causes (unpublished data from agency monthly and annual reports). An additional 24 wolves were captured and removed from the wild, which from a population dynamics perspective is equivalent to mortality (Paquet et al. 2001).

The EIS predicted livestock depredation rates of 1-34 head per 100 wolves. From 1998-2004 confirmed kills of livestock (cattle) by Mexican wolves averaged 14 per an adjusted population of 100 wolves (Mexican Wolf Blue Range Adaptive Management Oversight Committee and Interagency Field Team 2005, U.S. Fish & Wildlife Service 2006). In 2005 the rate increased to 45 head per 100 wolves. One factor contributing to livestock depredation in the Blue Range Wolf Recovery Area is the practice of year-round grazing with open range calving on a significant portion of the area.

The Mexican Wolf Recovery Plan was approved and adopted in 1982. Its objective is described above. FWS policy requires that recovery plans be reviewed every five years and updated or revised if they are out of date or not in compliance with the ESA. The Mexican Wolf Recovery Plan has never been updated or revised even though it does not contain "objective, measurable criteria which, when met, would result in a determination…that the species be removed from the list" (ESA Section 4(f)(2)(B)(ii)) nor a detailed plan for fully recovering Mexican wolves throughout a significant portion of their historic range to a population status that warrants delisting from the ESA. The current Mexican Wolf Recovery Plan has been in effect, in its original form, for 25 years and needs revision. Following the listing of a Southwestern Gray Wolf DPS, the FWS initiated a process for revising the recovery plan in October 2003 but suspended that effort in January 2005 after a federal court ruling that vacated the DPS listing (Defenders of Wildlife v. Norton, 03-1348-JO). Though the gray wolf remains listed as endangered in the Southwest under the 1978 listing rule, the FWS has not reinitiated the recovery planning process for the critically endangered Mexican gray wolf.

The final rule for the reintroduction project (Parsons 1998) required the Service to conduct a comprehensive review of the project at the end of the third and fifth year (i.e., March 2001 and March 2003). The Service contracted the 3-year review to the Conservation Breeding Specialist Group (CBSG) from the IUCN-SSC (World Conservation Union). The Five-Year Review was conducted internally (Mexican Wolf Blue Range Adaptive Management Oversight Committee and Interagency Field Team 2005).

The three-year review was conducted by a team of scientists led by wolf ecologist Dr. Paul C. Paquet (Paquet et al. 2001). Their key findings were: (1) survival and recruitment rates are far too low to ensure population growth and persistence; (2) livestock producers using public lands can make a substantive contribution to reducing conflicts with wolves through improved husbandry and better management of carcasses; and (3) dispersal of wolves outside the recovery area boundaries is required if the regional population is to be viable. They recommended that the regulation for the Blue Range reintroduction project be modified to allow wolves that are not management problems to establish territories outside the Blue Range Wolf Recovery Area boundary, and that livestock operators on public land be required to take some responsibility for carcass management or disposal to reduce the likelihood that wolves become habituated to feeding on livestock. Over the ensuing 6 years, none of the substantive recommendations in the Paquet Report has been implemented or initiated.

The internal five-year review set forth 37 recommendations, many of which are burdened by required processes (Mexican Wolf Blue Range Adaptive Management Oversight Committee and Interagency Field Team 2005). Some of the recommendations can improve the status of the Blue Range reintroduction project in the nest 2-5 years. Four provisions, however, are worrisome from a conservation perspective. These four would: (1) specify that new regulations will not address one of the known precipitators of wolf trapping and shooting—wolves' habituation to livestock or attraction to the vicinity of livestock through scavenging on untended livestock carcasses

(Recommendations 12.b. and 29); (2) allow wolf killing by private individuals in broader circumstances than presently permitted (Recommendation 10); (3) mandate that the current wolf management protocols apply to all new areas made available for wolf occupation, even though those protocols result in unsustainable failure rates (Recommendation 5.c); and (4) allow the states of Arizona and New Mexico and tribal authorities to cap the population of wolves in the bi-state area at 125 individuals and permit the killing of wolves above that number—a number admitted as having no scientific justification, and a number which has no relationship to recovery of wolves in the Southwest (Recommendation 11). The Mexican gray wolf is not currently on a trajectory toward recovery.

Lessons of Recovery Efforts To Date

The FWS removed federal protections from wolves in the Great Lakes in 2007 (*Federal Register* February 8, 2007 (Volume 72, Number 26)) and moved to delist the Northern Rocky Mountains DPS, but in September 2008 the FWS announced it's intentions to rescind the final rule amidst litigation. Notably, delisting for the gray wolf in the Great Lakes and Northern Rocky Mountains was proposed despite vastly different regional meta-population sizes (with the Great Lakes population being nearly three times larger than the Northern Rocky Mountains population). The primary differences between the size of these two regional wolf populations owes, in large part, to the fact that wolves in the Great Lakes were afforded the full protections of the ESA, while wolves in the Northern Rocky Mountains were given much less protection, and in fact suffered under intense control measures by the FWS, thus suppressing population growth.

From 2003, through 2008, FWS actions (i.e. delisting proposals and rule making processes) have underscored a consistent theme: the agency believes that wolves are recovered, and that the species should be delisted in as broad a landscape as possible. Yet, wolves occupy only about 5% of their original range in the lower 48 states. There are several areas of former range in the lower 48 states that provide excellent habitat for wolves, but where wolves are absent; chief among these areas is the Southern Rocky Mountains. Yet, the FWS has no plan at present to restore wolves to areas with good habitat, despite a scientific, ESA, and court emphasis interpreting recovery as occurring in a "significant portion of the former range." Recent studies show that habitat could support 1,000 or more wolves in the northeastern United States from New York to Maine (Harrison and Chapin 1998, Mladenoff and Sickley 1999).

The Southern Rockies Ecoregion contains almost 1.5 to 1.8 times more public land than is available to wolves in the Yellowstone area and central Idaho, and 6 times the amount of public land available to Mexican wolves in the Blue Range Wolf Recovery Area. A 1994 Congressionally mandated study concluded that the Colorado portion of the ecoregion could support over 1,000 wolves, mostly on public land (Bennett 1994). Mech (2000) proposed that because the ecoregion is nearly equidistant from the Northern Rockies and the Blue Range Wolf Recovery Area it is possible that a Southern Rockies population, through the production and movement of dispersers, would contribute to establishing and maintaining a metapopulation of wolves that extends from the Arctic to Mexico.

IV. Ecoregional Description - The Southern Rocky Mountains

For the purposes of this petition, the Southern Rockies ecoregion is described based on the U.S. Forest Service ecoregion classification system (McNab and Avers 1994) (reference Figure 1, Appendix A). Ecoregions are delineated based on similar patterns of topography, vegetation, soils, geology, species, and climate across a large landscape (Bailey 1995). The ecoregion classification boundaries are the primary boundaries, with some minor modifications, such as adding major valleys that are surrounded by the Southern Rockies but that the Forest Service classified as part of other ecoregions.

Importantly, although this petition discusses recovery planning for the gray wolf in the Southern Rocky Mountains, the best scientific and commercial data available have already identified the best available habitat for wolf recovery in the Southern Rocky Mountains (Carroll et al. 2003, 2006), and it shall be assumed henceforth that references to recovery planning and critical habitat designation be focused on those areas identified by Carroll et al. (*Ibid*.). See also, Figure 5, Appendix A.

The Southern Rockies ecoregion is a large landscape, covering about 16,681,839 hectares (166,818 km^2), or an area roughly equivalent (in the aggregate) to that of the New England states. The region stretches north to south from Casper, Wyoming to Albuquerque, New Mexico; and east to west from Denver to Grand Junction, Colorado.

The Southern Rockies comprise a region known for magnificent high-mountain scenery. Surely this is a deserved reputation, with 54 peaks higher than 14,000 feet (4,267 m) in elevation, as well as countless other peaks of only slightly lesser stature. In addition to high peaks, much of the region is dramatic and rugged, consisting of rocky outcrops, topographically tortured foothills, and shockingly deep and narrow river gorges. Yet, for those that know the region well, there is no satisfaction in this overly simplistic characterization of the landscape. There is a less dramatic side to the Southern Rockies as well, including several vast intermountain basins, gently rolling foothills, and high, broad plateaus (Shinneman et al. 2000).

The wide elevation ranges and complex landforms that comprise the Southern Rockies cause uneven distribution of moisture and significant differences in temperature — often over short distances — and thus lead to sharply contrasting local climates. These diverse climatic conditions help support an equally diverse array of natural communities and native species. The Southern Rockies region is also diverse because of its location as a biological meeting place, where species converge from the boreal forests to the north, the grassland steppes (prairies) to the east, and the semi-deserts to the south and west. In short, the Southern Rocky Mountains ecoregion is a ruggedly beautiful, diverse, and complex landscape that is collectively unique and distinguishable on the whole from those of surrounding ecoregions.

Although the Southern Rockies have lost several native species—including the gray wolf—as a result of human settlement, persecution, and overuse of natural resources, and while many species and ecosystems are at risk, a significant portion of the ecoregion's natural landscapes remain relatively intact. These remaining natural landscapes are important to regional and global conservation goals, as they are capable of supporting biological elements both unique to, and representative of, the Southern Rockies. Moreover, they offer increasingly rare opportunities to restore wild nature and native species. In short, although humans have altered the natural landscape, conservation opportunities still abound in the Southern Rockies.

GEOLOGY AND LANDFORMS

The Southern Rocky Mountains ecoregion looked radically different during eons past, subjected to an ancient and complex geologic history. Oceans covered the ecoregion for billions of years, until the Ancestral Rocky Mountains arose roughly 300 million years ago near the Earth's equator. At that time, the land was part of the supercontinent Pangaea. These ancient mountains were leveled over time, and the current Southern Rockies rose roughly 70 million yeas ago as a result of the Laramide Orogeny, a period of mountain-building that occurred toward the end of the Cretaceous period (Benedict 1991, Knight 1994). Post-Laramide erosion, deposition, uplift, and volcanism continued to modify the Southern Rockies' mountainous landscape. During the last 2 million years localized volcanism and extensive glaciation were the main forces, with as many as 17 major glacial episodes during the Pleistocene epoch (Benedict 1991, Blair 1996, Flannery 2001).

The result of these powerful geologic forces is the complex physiography of the Southern Rockies today, largely dominated by mountain ranges with dramatic high peaks. The numerous ranges that form the Southern Rockies generally run in a north-south direction, and they are mainly folded and faulted uplifts interspersed with volcanics (Benedict 1991). These include the Laramie Mountains, the Medicine Bow Mountains, the Park Range, the Front Range, the Wet Mountains, the Elk Mountains, the Gore Range, Sawatch Range, the San Juan Mountains, the Jemez Mountains, the Sangre de Cristo Mountains, and many others. The mountainous landscapes contain an assortment of igneous and metamorphic rock, but younger sedimentary rock is common along the ecoregion's margins, and volcanic rock is found throughout southcentral Colorado and northern New Mexico (Ellingson 1996).

The Southern Rockies are the highest ecoregion on the North American continent, with 20% of land area resting above the elevation of 3,000 meters (9,900 feet) (Shinneman et al. 2000). There are 54 peaks that rise above 4,267 meters (14,000 feet), all in Colorado. The highest point is Mount Elbert, which rises to 4,399 meters (14,433 feet). Colorado also has the lowest elevation of the Southern Rockies, roughly 1,385 meters (4,570 feet), along the Gunnison River on the west slope.

The ranges of the Southern Rockies show classic high-mountain topographical features, such as alpine cirques and tarns, glacial moraines, broad U-shaped valleys, and glacial-outwash plains at lower elevations. Today glaciers are small in extent and limited to high elevation cirques, but periglacial activity, water flow, and wind continue to erode and shape the ecoregion's mountainous landscape (Benedict 1991, Blair 1996).

On the east slope, the Southern Rockies descend into a complex assortment of mesas, foothills, hogbacks, parallel ridges, and rocky outcroppings. The topography then unfolds into the short-grass prairie, a drought-driven system in the rain-shadow of the mountains (Flores 1996). On the west slope, the mountains subside into rugged canyons and mesas, including the massive White River and Uncompahgre Plateaus, contradicting the ecoregion's popular image of a land of jagged high-peaks. Ancient volcanic activity, especially in places like the San Juan and Jemez Mountains, has created large calderas, ancient lava flows, volcanic dikes, and extinct, eroded volcanic domes (Ellingson 1996). The post-Laramide erosion and deposition created several large, relatively flat, intermountain basins, such as the San Luis Valley and South Park (Benedict 1991). Streams and rivers have further shaped the landscape by cutting deep rocky gorges and narrow V-shaped canyons.

Drainage Basins and Aquatic Systems

As moisture-laden weather systems pass over the Southern Rockies, the mountains squeeze out rain and snow, creating an ecoregion that is generally wetter than surrounding areas. This high-elevation moisture forms the headwaters of some of the continent's major river systems. West of the Continental Divide, water flows to the Pacific Ocean via the Colorado River to the Gulf of California. On the east slope, water travels to the Atlantic through the Gulf of Mexico by two main routes: the Rio Grande drains directly into the Gulf, while the North and South Platte Rivers and Arkansas River empty their aquatic loads indirectly via the greater Mississippi/Missouri River system.

The Southern Rockies have nearly 48,000 kilometers (30,000 miles) of perennial creeks, streams, and rivers scattered throughout the ecoregion (Shinneman et al. 2000), ranging from clear, cold, fast high-mountain creeks to relatively slow moving, wide, lower-elevation rivers. Natural deep water lakes are numerous, but roughly 90% are found above 2,700 meters (9,000 feet) (Colorado Water Resources Research Institute 2001). Wetlands of various types are found throughout the ecoregion, from willow (*Salix sp.*) carrs scattered throughout the high country to large playa lakes that are generally found in the San Luis Valley. Groundwater and aquifers occur throughout the ecoregion, and the largest is the San Luis Valley Aquifer, which supports numerous shallow wetlands and springs (Pearl 1974).

CLIMATE

On a regional level, the climate of the Southern Rockies is a temperate, semi-arid, steppe regime (McNab and Avers 1994), with generally sunny weather, warm summers, and cool winters. Regional weather is influenced by interrelated factors, including the latitude, mid-continent location, north-south alignment of mountain ranges, and major weather patterns, such as winter storm tracks and jet stream locations (Benedict 1991). These regional factors are influenced locally by topographic aspect and elevation (Benedict 1991, Knight 1994). Lower elevations tend to have hot summers and cool winters with semi-desert levels of moisture, while higher elevations are cooler and wetter with short growing seasons (Figure 2, Appendix A). The highest elevations experience long harsh, snowy winters.

Due to prevailing westerly weather patterns, the western mountains tend to be wetter than eastern slopes, with most precipitation coming in the form of snow (Neely et al. 2001). In fact, while roughly 60% of the Southern Rockies' surface area drains eastward, more than 75% of the precipitation falls on the west slope (Benedict 1991). This influences the spatial distribution of aquatic and riparian ecosystems in the Southern Rockies, as well as the human attempts to use and redistribute water. The latter has had dramatic impact on aquatic ecosystems.

Climate differences can be quite pronounced over short distances. Portions of the San Luis Valley in Colorado average about 18 centimeters (7 inches) of precipitation a year, while some locations in the nearby San Juan Mountains receive more than 140 centimeters (55 inches), mainly in the form of snow (e.g., Wolf Creek pass averages about 11 meters [36 feet] of snow per year). Temperatures can also vary greatly over relatively short distances. Boulder, Colorado at 1,631 meters (5,382 feet) has an average July high temperature of 30.5 C° (86.9° F) while at nearby Berthoud Pass (3,480 meters or 11,484 feet) the average July high temperature is only 16.5 C° (61.7° F) (Western Regional Climate Center Database 2001). In addition, in the face of climate change, the north-south alignment of mountain ranges throughout the Southern Rockies and North America means that human-induced temperature changes may be magnified (Flannery 2001).

NATURAL PROCESSES AND LANDSCAPE PATTERN

Natural processes play important roles in maintaining ecological integrity, and they include energy flows, nutrient cycles, hydrologic cycles, disturbance regimes, succession of natural community types, pollination, and predator-prey relationships (Noss and Cooperrider 1994). These processes make ecosystems diverse, dynamic, resilient, and naturally evolving. Fires, floods, wind storms, landslides, insect infestations, or diseases help to create landscape mosaics over space and time by influencing the composition, physical structure, and function of ecosystems. Spatial and temporal characteristics of such natural disturbances within an ecosystem type define a disturbance regime (Pickett and White 1985).

In the Southern Rockies fire is a particularly important disturbance agent. In general, the dense continuous crown cover in upper montane and subalpine forests support occasional but extensive stand-replacing fires, while many lower montane and foothill forests experienced low-intensity surface fires carried by fine surface fuels like grasses (Veblen 2000). The ecoregion's grassland and shrubland fire regimes are less well-understood (Knight 1994). However, within many community types, fires vary in intensity and size over space and time, creating a shifting mosaic of patch age structures and patch types (Pickett and White 1985). Disturbed patches typically go through various "successional stages" over time, until a relatively stable stage, such as an old-growth forest, eventually returns (Knight and Wallace 1989). In other cases, such as old-growth ponderosa pine (*Pinus ponderosa*) forests, a regime of low-intensity surface fires may actually maintain relatively steady-state conditions over long periods by thinning forest stands and maintaining large, old trees and grassy understories (Covington and Moore 1994). Yet, even these forests experience stand-replacing disturbances occasionally, and for some ecosystems, these less predictable and more variable disturbance regimes may even be the "norm" (Reice 1994). Natural disturbances support dynamic and healthy ecosystems and provide habitat for native species. Thus, human alteration and disruption of natural disturbance regimes in the Southern Rockies is of concern for many ecologists (e.g., Veblen and Lorenz 1991, Kipfmueller and Baker 2000, Romme et al. 2000).

One way to assess natural conditions is to examine how the mosaic of natural communities are spatially distributed across a landscape, such as an ecoregion or a watershed; important indices include patch size, patch configuration, boundaries between patches, and connectivity (Forman and Godron 1986). However, depending on the ecological element or process of interest, the appropriate scale, detail, and resolution at which to measure landscape structure may vary (Wiens 1997). For instance, in the Southern Rockies subalpine forests often cover hundreds of thousands of contiguous hectares (1 hectare equals 2.47 acres) and, in a rough sense, can be viewed as one large patch or matrix community that dominates a given landscape area. Yet, within the forest matrix, smaller patches of different forest ages (e.g., old-growth stands, dense pole-sized stands) and cover types (e.g., aspen forest, montane riparian shrublands) will exist, due to disturbance histories and environmental gradients.

Recognizing that these different landscape patterns exist at different scales has great relevance for species conservation. While a habitat generalist such as an elk (*Cervus elaphus*) or wolf move easily through the subalpine forest landscape matrix, an American marten (*Martes americana*) is sensitive to the natural or human-induced patchiness within the forest matrix. The amount of connected forest habitat with dense stands of old trees and downed snags limits American marten dispersal success (Buskirk and Ruggiero 1994). Although much of the landscape before European colonization was patchy, other areas consisted of extensive expanses of forest that represented continuous habitat for many interior dependent species (Knight and Reiners 2000). The loss and fragmentation of such large interior habitat due to logging, road-building, and residential development is of increasing concern to scientists, land managers and conservationists in the Southern Rockies ecoregion (e.g., Knight et al. 2000). Although wolves are habitat generalists, the effects of habitat fragmentation and road building on the species and associated prey species are important considerations for the purposes of recovery planning and management.

FINAL THOUGHTS ON THE SOUTHERN ROCKIES ECOREGION

In the Southern Rockies, few if any ecosystems remain significantly unaltered by humans (see Section V. for more information). Some, such as aquatic and riparian communities, have been severely degraded. Hundreds of native species are of conservation concern. In addition, rapidly increasing human population and development in the Southern Rockies will degrade more ecosystems.

Yet, compared to other areas in the U.S., the Southern Rockies ecoregion still contains many opportunities to protect and restore its vast biological wealth and diversity. Large matrix communities, such as subalpine forests, remain relatively intact throughout the ecoregion and in similar patterns of distribution as when Euro-Americans first settled the ecoregion. Despite the negative effects of fire exclusion in some fire-dependent ecosystem types, the ~50 years of effective fire suppression have probably not significantly altered the forests, woodlands, and other natural communities with long-rotation fire regimes, which typically experience stand-replacing events on the order of hundreds of years (Romme and Despain 1989, Shinneman 2006). Moreover, many areas that experienced significant anthropogenic disturbance in the Southern Rockies, such as logging, road-building, overgrazing, and even damming and fire exclusion, can be restored, especially where they exist on public lands. Notably, climate change could have a profound impact on the ecological communities of the Southern Rocky Mountains. Habitat protection and restoration is a paramount concern for land managers in order to buffer these ecosystems against climate change (Markham 1996; Bravo, et al.2008).

Perhaps one of the most profound ecological changes wrought upon the Southern Rocky Mountains in the last century has been the cascading simplification of ecosystems in the wake of wolf eradication. Rocky Mountain National Park, northwest of Denver, Colorado, is presently planning to cull hundreds of elk per year in order to mitigate against the absence of a coursing predator (wolves) which has led to a severe decline in the abundance of aspen and willow in the Park (*Federal Register* 2007, Vol. 72, Number 237). Notably, as described elsewhere in this document, research in Yellowstone National Park indicates that the reintroduction of wolves has had a significantly positive influence on the regeneration of aspen and willows, especially in riparian areas, due to the resulting increase in vigilance of elk (Ripple and Betscha 2003; 2004)

As noted earlier, Carroll, et al. (2003, 2006) identified the best available habitat for wolf recovery in the Southern Rocky Mountains. Thus, the specific areas identified by Carroll et. al are the most appropriate subsets of this vast ecoregion to focus on for the purposes of recovery planning and critical habitat designation.

V. THREATS TO THE SPECIES

FWS is required to list, delist, or reclassify a species as endangered or threatened due to any one or a combination of the following factors:

A) the present or threatened destruction, modification, or curtailment of its habitat or range;

B) overutilization for commercial, recreational, scientific, or educational purposes;

C) disease or predation;

D) the inadequacy of existing regulatory mechanisms; or

E) other natural or manmade factors affecting its continued existence.

In addition to analysis under these five factors, FWS is required to make listing determinations "solely on the basis of the best scientific and commercial data available," without reference to the possible economic or other impacts of such a determination. 16 U.S.C. § 1533(b)(1)(A); 50 C.F.R. § 424.11(c). Given that a recovery plan should address the listing factors that have caused a species' imperilment, this petition reviews the listing factors as applied to the gray wolf in the Southern Rockies, based on the best scientific and commercial data available.

Application of Listing Factors to the Conservation & Recovery of the Species.

The purpose of this petition is to stimulate the development of a recovery plan for gray wolves in the Southern Rocky Mountains and the concurrent designation of critical habitat for the species in the ecoregion. Listings Factors A-C are directly applicable to the determination of the need for a recovery plan for the gray wolf in the Southern Rocky Mountains, inasmuch as recovery planning flows from the mandate for the FWS to "conserve" the species, 16 U.S.C. § 1533(f).

Ergo, the ESA's mandate to "conserve" gray wolves requires due diligence to achieve delisting (16 U.S.C. § 1532(3)), and thus the recovery plan must remove or address any and all of the five listing factors that contributed the listing of the species and that, in this instance, remain impediments to the species recovery in the region. Moreover, the FWS shall prioritize recovery plans for species that would benefit the most from such plans § 1533(f)(1)(A). Each of the listing factors discussed below, therefore, shall be considered as contributing impediments to the recovery of the species in the Southern Rocky Mountains, and as tangible reasons to designate critical habitat 16 U.S.C. § 1532(5)(A).

The primary threat facing wolves in the Southern Rocky Mountains is conflict with domestic livestock. Continued degradation and fragmentation of habitat also poses long-term threats to the species (Carroll et al. 2003, 2006) within the region. Given these threats, reintroduction is imperative to the recovery of the species (Carroll et al. 2003, 2006), and critical habitat designation will help ensure that FWS and federal land managers more vigilantly curtail harms against wolves and their habitat. Below, we explore each applicable category of threat as it applies to the ability of the species to be recovered in the Southern Rocky Mountains, and as it applies to the need to designate critical habitat for the species in the region.

FACTOR A. THE PRESENT OR THREATENED DESTRUCTION, MODIFICATION, OR CURTAILMENT OF ITS HABITAT OR RANGE.

Impacts to wolf habitat may significantly hinder wolf recolonization in the Southern Rocky Mountains, as discussed in detail below. Given that the species is presently extirpated from the region, the development of a recovery plan for the species and the designation of critical habitat are crucial to conserving the species.

Barring significant changes in land management policies, U.S. Forest Service (USFS) Wilderness areas, and other State and Federal lands will continue to be managed for significantly high seasonal densities of domestic livestock, increasing development of energy extraction facilities, and increasing road densities that could reduce the density of native prey, increase the potential for livestock conflicts, and generally expose wolves to excessive unregulated human-caused mortality. The best available scientific data indicates that the core recovery areas identified in the Southern Rocky Mountains face significant long-term risk from potential change in human-associated impact factors (e.g., increased road density and human population), thus threatening the viability of a future population of wolves in the region (Carroll et al. 2003, 2006).

Suitable Habitat

Wolves once occupied or transited most, if not all, of the Southern Rocky Mountains. However, much of the wolf's historic range within this area has been modified for human use and is presently in need of restoration to be suitable for wolves. The best scientific and commercial data available ranks areas as suitable habitat if they have characteristics that suggest a 50 percent or greater chance of supporting wolf packs (Carroll et al. 2006). The model used by Carroll et al. (2006) typically characterized suitable wolf habitat in the region as public land with mountainous, forested landscapes containing abundant year-round wild ungulate populations, low road density, and low human population density.

Previous studies that focused specifically on the Southern Rocky Mountains predicted that the region could potentially support 1000 wolves, primarily on public lands (Carroll et al. 2003). Yet, the model used by Carroll et al. (2003) made clear that suitable habitat within the Southern Rocky Mountains was threatened by future development trends. In particular, the Carroll et al. model suggested that development trends over 25 years could eliminate one of four potential regional sub-populations and increase isolation of the remaining areas (*Ibid*.). The resulting reduction in carrying capacity due to development in the region ranged from 49% to 66%, depending on the model's assumptions about road development on public lands. (*Id*).

Given the results of the Carroll et al. (2003) study, the results of which are borne-out by other work as outlined below, it is imperative that the Service: 1) develop a recovery plan for wolves in the Southern Rockies; 2) designate critical habitat for wolves in the Southern Rocky Mountains; and 3) conduct consultation regarding wolves prior to major federal actions that may affect wolf habitat in the region.

Conflicts with livestock

<u>The primary cause of wolf extirpation and local extinction in North America was conflicts between wolves and livestock </u>(Young and Goldman 1944, Young 1970). Prior to European settlement of North America, gray wolves roamed most of the conterminous United States, except for the Gulf coast region east of Texas where the red wolf (*Canis rufus*) occurred (Young and Goldman 1944, Nowak 1983). As early as 1630 conflict with agrarian interests resulted in government-supported wolf eradication campaigns in Massachusetts (Young and Goldman 1944, McIntyre 1995).

Yet, it wasn't until the late 1800s that wolf eradication reached its zenith in the West, precipitated by near total eradication of the species native prey (i.e., bison, elk, and deer) by hunters endeavoring to satiate a hungry nation (Schmidt 1978, U.S. Fish & Wildlife Service 1987a). Aiming to subdue the continent's indigenous peoples, federal agents and settlers also killed bison, a mainstay of the plains tribes (Isenberg 1992). Faced with a precipitous decline in their native prey, wolves understandably turned to depredating on domestic livestock, which by the mid 1800s were ubiquitous in the American West. In turn, the federal government and private citizens ginned up efforts to completely extinguish wolves.

Without question, wolves were taking a toll on domestic livestock producers, and the stories of their exploits fueled a pathologic hatred for wolves (Robinson 2005). Some particularly renown wolves attained mythical status, with monikers like Rags the Digger, Old Two Toes, Custer Wolf, and Lobo the King of the Currumpaw and his mate Blanca (Caras 1966; McIntyre 1995, Robinson 2005). These infamous wolves were rumored to kill large numbers of livestock, and most seemed to have an uncanny ability to avoid capture.

Notably, the chasm between myth and reality is often vast, and so it was with the legendary appetites of these last wolves. Gipson et al. (1998) evaluated the credibility of several early accounts, calculating kill rates for 14 famous wolves. The team determined that, according to recorded accounts, each wolf must have consumed an average of 48 kg (about 100 lbs.) of cattle flesh per day. Although Gipson et al. (1998) considered several possible explanations for the impossibly high consumption rates, they concluded that early authors had fabricated information related to the wolves.

By the early 1900s, fueled by the mythos surrounding these famous wolves, the livestock industry secured a federal commitment to wolf control (i.e., extermination). In 1915, Congress began appropriating funds for wolf control, assigning the mission to the newly created U.S. Biological Survey (Robinson 2005). The early contributions of the livestock industry to this program gave them considerable influence over policy (Leopold 1964, Dunlap 1988, Robinson 2005). The Survey's internal reports revealed that the agency aimed for "absolute extermination" of the wolf, using poisoning as the main method (McIntyre 1995, Robinson 2005).

Within 15 years, the Survey was so extensive that it created a new division to coordinate predator eradication: the Division of Predatory Animal and Rodent Control (DiSilvestro 1985, Dunlap 1988, Robinson 2005). In 1931, Congress authorized the trapping, poisoning, and shooting of wildlife on federal or private lands through a law called the Animal Damage Control Act (Dunlap 1988, Robinson 2005). Bean (1983) argues that the Animal Damage Control Act also indirectly sanctioned the partnership between this new division and the livestock industry.

It is worth noting that wolves were not safe from eradication on public lands or parks. To the contrary, government agents and settlers alike killed wolves on private and public land. Even in YNP, from 1918 to 1935 government hunters killed 114 wolves (Phillips and Smith 1996).

The cultural context and geographic extent of the war on wolves provides a strong foundation upon which to understand the contemporary threats posed to the species during and after recovery. Yet, it is the actual methods of warfare used to eradicate wolves that clinch this argument. At its zenith, the wolf eradication program literally matched the efforts to win World War I. The soldiers in this war were the "wolfers" (professional wolf killers), who employed every method possible to kill wolves (Mech 1970, McIntyre 1995, Robinson 2005). They trapped, shot, and poisoned wolves; they and even roped them like livestock and dismembered them (Gilbert 1995). Leaving no stone unturned, the wolfers dug wolf pups from their dens and then clubbed them to death. Finally, they laced carcasses and meat scraps with the strychnine and compound 1080, broadcasting across thousands of square miles of landscape (Gilbert 1995, Robinson 2005). In the end, poisoned baits proved the most efficient technique for killing wolves over large areas. The poisoning campaign likely guaranteed the ultimate destruction of the species in the lower 48 states. By the 1940s, wolves were but ghosts in the lower 48 (Young and Goldman 1944, Young 1970, Brown 1983, Nowak 1983, Robinson 2005).

Depredation

One of the primary contemporary threats to a recovering wolf population is the presence of livestock within areas occupied by wolves (Oakleaf et al. 2005, Musiani et al.2005). Although Oakleaf (2005) and the Service (2007) argue that the presence/density of livestock on the landscape is an acceptable parameter to determine the "suitability" of habitat for wolves, it is, in fact, arguable that the results of Oakleaf et al.'s (2005) model prove that livestock are the primary threat to wolf recovery.

As outlined in the previous section, it was the conflict between wolves and livestock that led to the demise of the species. Yet, in arguing that gray wolves in the NRM had been recovered, the FWS (2007) relied upon Oakleaf et al. (2005) to classify a significant portion of the NRM as "unsuitable" wolf habitat based primarily upon the presence of livestock (and the implicit risk of depredation thereon) and road density. Absent these alleged threats, the Service was at a loss to define this historic range as unsuitable—and wolf presence therein non-viable.

Notably, the FWS's reliance upon anthropogenic threats as cause to drastically shrink what it classifies as the species' range runs counter to the mandate of ESA and precedents for other recovered species. Had the FWS taken this approach to the recovery of the Brown Pelican or the

Peregrine Falcon, for example, the range of these birds would have been defined as, "anywhere the species ranged historically, minus those areas where DDT (the primary threat to the species) is present in the environment." By that logic, the FWS could have then reclassified the species as recovered, since it was extinct or nearly extinct in all areas where DDT was present.

The above arguments notwithstanding, the fact is that the federal government has authorized the killing of 724 wolves from 1987 through 2007 in the NRM as a result of wolves depredating or being suspected of depredating on livestock (U.S. Fish & Wildlife Service 2007b). Ironically, had critical habitat been designated for wolves in the NRM, the resulting consultation actions mandated under section 7 of the ESA may well have helped expedite wolf recovery, at a greatly reduced cost, because hundreds of wolves would have been allowed to live, and livestock conflicts would have to have been dealt with in a more progressive and proactive manner.

Habitat fragmentation

As noted previously, Carroll et al. (2003) made clear that suitable wolf habitat within the Southern Rocky Mountains was threatened by future development trends. In particular, their model suggested that development trends over 25 years could eliminate one of four potential regional sub-populations and increase isolation of the remaining areas (Carroll et al. 2003).

Roads

In the Southern Rockies, high road densities have left the landscape fragmented. Beginning with Colorado's mining boom, through the mid 1900s, the construction of roads transformed the landscape of the Southern Rockies. Between 1930 and 1940, Colorado's paved roads grew from roughly 800 to 6,400 km (500 to 4,000 miles) (Noel et al. 1994).

The contemporary landscape of the Southern Rocky Mountains is a latticework of more than 121,600 km (approximately 76,000 miles) of primary and secondary roads, a figure that does not even include most residential streets and thousands of miles of poorly mapped or undocumented primitive roads (Shinneman et al. 2000). National Forest lands in Colorado are crisscrossed by more than 17,339 miles of inventoried roads (Finley 1999). Local road densities are often much higher than expected, even in relatively undeveloped areas. For example, New Mexico's Bandelier National Monument averaged over 16 km (10 miles) of roads per square mile, according to one report (Allen 1994). By comparison, several expanses of the Southern Rockies remain relatively roadless, particularly those proximal to large wilderness areas, such as in portions of the San Juan Mountains and on the White River Plateau. Notably, with the exception of these rare, expansive roadless tracts, few places in the Southern Rockies are more than 6.4 km (4 miles) from the nearest road (Shinneman et al. 2000). Most importantly, although alpine and subalpine habitats contain few roads, lower elevation and more biologically diverse habitats are usually the most heavily roaded in the Southern Rockies. *Id*.

Although wolves are highly adaptive habitat generalists, the ubiquity of roads in the region may have a significant impact on the long-term viability of a restored wolf population (Carroll et al. 2003). Roads are known to have significant harmful effects on native species and ecosystem function (Schoenwald-Cox and Buechner 1992, Trombulak and Frissell 2000). The negative impacts of roads include:

- Greater human access to habitat interiors for activities such as fuel-wood gathering, hunting, poaching, plant gathering, and recreation in those areas (Lyon 1983; Trombulak and Frissell 2000);

- Increased dispersal of edge-adapted, weedy, aggressive, predator, and parasitic species due to the travel corridor effect (Tysor and Worley 1992, Parendes and Jones 2000);

- Increased species mortality due to automobile collisions (Bangs et al. 1989, Fuller 1989);
- Reduced species mobility, including both small and large animals, due to the barrier effect (Fahrig et al. 1995, Foster and Humphrey 1995);
- Increased sediment and pollution runoff into nearby streams and wetlands (Bauer 1985; Forman and Deblinger 2000);
- Increased likelihood of severe erosion of roads on steep slopes (Trombulak and Frissell 2000).

These factors interact in myriad ways, fragmenting and isolating natural habitat, leaving formerly intact vegetation patches subdivided and creating a "road effect zone" that changes the habitat conditions and species compositions well into the interiors of adjacent natural habitat (Reed et al. 1996, Shinneman and Baker 2000, Forman 2000).

The relative impact of roads is influenced by a variety of factors. Case in point: A primitive, lightly used dirt road may not limit the movement of some species, while a busy, paved four-lane highway may prove an impermeable barrier to many wildlife species. Importantly, management options such as road closure during animal breeding or "mud season" may dampen the negative ecological effects of roads, but such measures fail to address the cumulative scale of road impacts. Specifically, road density is an important factor impacting wildlife. Further, roads provide a means of ingress for humans that may ultimately result in harm to wolves (Lyon 1983; Trombulak and Frissell 2000). For example, a Mexican wolf was found shot on the side of a dirt road in the Gila National Forest in 2003.

Studies have demonstrated that high road densities affect species such as elk, mountain lion, wolves, black bear, and grizzly bears. These species may not persist in road-fragmented habitat, or may persist in significantly lower densities due to an aversion to roads or negative impacts from increased human hunting, poaching, and harassing (Lyon 1983, Van Dyke et al. 1986, McClellan and Shackleton 1988). For instance, studies suggest that wolves generally do not persist where road densities exceed 0.45 km/km2 (0.28 mi/mi2) (Mladenoff et al. 1995, Potvin et al. 2005). The road density of many federally managed lands within the Southern Rockies are presently trending above the threshold limit identified by Mlandenoff et al, and as discussed in Carroll, et al. (2003, 2006) this fact threatens to reduce the amount of available habitat for wolves in the Southern Rockies by 2025.

Collisions with vehicles

Studies in Italy have found that collisions with vehicles are the primary detectible source of mortality for wolves there (Lovari et al. 2007). In Canada, studies have shown that collisions with vehicles are a significant cause of mortality for large carnivores (Waters 1988, Kansas et al. 1989, Woods 1991, Gibeau 1993, Paquet 1993, Thurber 1994). Further, studies suggest a correlation between time spent on the roadway and probability of lethal collisions (Waller 2005).

Effects of roads on wolf/prey distribution and habitat use

Theoretical and empirical research shows that highways and railroads can fragment wildlife habitats, with potentially negative consequences (Noss et al. 1996). Indirect impacts from roads such as habitat fragmentation, direct habitat loss, increased human development, increased motorized access, and habitat displacement also account for substantial human-caused mortality of predators (Ruediger 1996).

A study of the effects of roads and trails on the behavior of wolves in Jasper National Park (Canada) suggests that, although roads and trails were not complete impediments to wolf movement, they altered wolf movements across their territories (Whittington et al. 2004). Notably, wolves in this study avoided crossing high use roads and trails more than low use roads and trails, indicating a clear impact on habitat quality as it relates to wolves.

Roads and road density may also effect wolves indirectly, via their effects on select prey species such as elk & deer. Wildlife biologists have been researching the relationship between roads and elk in the Western United States for several decades. This research overwhelmingly demonstrates that elk avoid forest roads (Lyon 1983, Thomas et al. 1979, Christensen et al. 1993, Lyon and Jensen 1980). Elk aversion to roads is mostly associated with vehicular traffic. Therefore closing (or obliterating) roads is an important management option for improving elk habitat. A 1983 study by L. Jack Lyon showed that elk habitat effectiveness can be expected to decrease by at least 25% with a density of one mile of road per square mile of land (m/m2), and by at least 50% with a density of 2 m/m2. This same study concluded that the best method for obtaining full use of habitat is effective road closures.

Human Developments

Studies of the cumulative impacts of human developments (mines, other energy extractive developments, housing developments) on large carnivores indicate that such developments have a significant negative impact on habitat effectiveness (Johnson et al. 2005). In one study, wolves strongly avoided major developments. *Id*.

Human impacts pervade most North American ecosystems. Exploration and development of oil and gas, minerals, and forest products; the expansion of rural and suburban housing; and increases in leisure, travel, and recreation activities have resulted in a greater presence of people across areas that were once exclusive habitat for flora and fauna (Ceballos and Ehrlich 2002). The range of potential and documented effects is extensive and often varies across species, populations, and time, including seasons or following a period of exposure (Blumstein et al. 2003, Beale and Monaghan 2004).

The construction of facilities, such as roads, trails, or buildings, and increased presence of humans, beyond some threshold, will result in a direct loss of habitats, or indirectly following avoidance behavior of affected wildlife (McLellan and Shackelton 1988, Cameron et al. 1992, Mace and Waller 1996, Stevens and Boness 2003). Human facilities, especially roads, trails, pipelines and other linear developments, also can fragment and isolate habitats (Baldwin et al. 2004, Deng and Zheng 2004, Jedrzejewski et al. 2004, McDonald and St. Clair 2004, Vistnes et al. 2004).

In addition to a loss or reduction in the effectiveness of habitats, disturbance may result in response behaviors with negative social or physiological consequences (Van Dyke et al. 1986, Skogland and Grøvan 1988, Bradshaw et al. 1997). Disruption of breeding or rearing activities, for example, can reduce fecundity and recruitment (White and Thurow 1985, Goodrich and Berger 1994, Linnell et al. 2000, Mullner et al. 2004). The nutritional or hormonal costs of avoiding or responding to a disturbance may have cumulative and important implications for individual fitness and population productivity (MacArthur et al. 1979, Fowler 1999, Kerley et al. 2002, Constantine et al. 2004). More directly, human access can increase mortality through non-monitored and controlled hunting, vehicle collisions, or the removal or destruction of problem animals (Johnson and Todd 1977, Johnson 1985, Del Frate and Spraker 1991, Wilkie et al. 2000, Johnson et al. 2004). Human presence and activities also can alter interspecific interactions, namely rates of predation (Rich et al. 1994, James and Stuart-Smith 2000, March and and Litvaitis 2004).

Population and economic growth inevitably spur land development. Interestingly, the physical expansion of residential housing in the Southern Rockies exceeds population growth for three reasons: an increase in lower-density suburban development, the boom in exurban and ranchette rural development, and the growth in second homeownership in the Southern Rockies (twice the national average and not reflected in population statistics) (Theobald 2000). Thus, the impact of urban sprawl and expansion of low-density housing developments on natural landscapes in the Southern Rockies and surrounding areas is even greater than the high population growth rates suggest and is among the most significant agents of landscape change.

Moreover, the negative impact of housing expansion on ecosystems and species is actually much greater than the total area developed. Scattered, low-density development fragments habitat. In many mountain valleys and foothill forests, low-density exurban developments occur along public-private land ownership boundaries and can block wildlife movement. This can isolate wildlife habitat on surrounding public lands. *Id*.

Developed areas also create *disturbance zones* that extend beyond the actual development and into adjacent natural habitat. Predation by household pets (cats are particularly destructive), the spread of noxious weeds, increases in aggressive human-adapted species (e.g., raccoons, *Procyon lotor*, striped skunks, *Mephitis mephitis*, or starlings, *Sturnus vulgaris*), introduction of detrimental wildlife attractions (e.g., trash cans), and increases in recreational activity surrounding developed areas greatly affect ecological integrity (Knight 1995). The extended zone of negative effect for songbirds and medium-sized mammals is similar around low-density housing development and dense development; indeed, low-density housing may produce a greater overall impact due to the larger landscape area required (Odell and Knight 2001).

Moreover, human communities often suppress important natural disturbance processes—such as fires and floods—around developed areas to protect houses and businesses. The proximity of much of the region's housing developments to forestland restricts options for managing natural disturbance on public lands, in particular the ability to allow natural and ecologically beneficial forest fires to burn (Shinneman et al. 2000, Theobald 2000).

Using housing-unit data from U.S. Census Block Groups, Theobald (2000, 2001) calculated historical and future spatial trends in development patterns for the region. Looking specifically at the Southern Rockies ecoregion (and not the county-defined region), land within urban (>1 housing unit per ha) and suburban (1 unit per 1-4 ha) development grew from roughly 415 km^2 (162 mi^2) in 1960 to 1,729 km^2 (675 mi^2) by 1990. Research suggests that this area will grow to roughly 3,853 km^2 (1,505 mi^2) by 2020 and to 5,434 km^2 (2,122 mi^2) by 2050. Exurban development (1 unit per 4 to 16 ha) grew from roughly 1,877 km^2 (733 mi^2) to 5,928 km^2 (2,315 mi^2) between 1960 and 1990, and it is projected at roughly 8,398 km^2 (3,280 mi^2) by 2020 and 11,065 km^2 (4,322 mi^2) by 2050. Exurban, suburban, and urban developments collectively covered about 7,508 km^2 (2,933 mi^2) (4.6% of the ecoregion) in 1990 and are projected to grow to 16,598 km^2 (6,483 mi^2) (10% of the ecoregion) by 2050.

This pattern of development is mainly concentrated in mountain valleys, foothills, and lower elevation valleys (Shinneman et al. 2000, Theobald 2000). These areas often include valuable agricultural lands and species-rich wildlife habitat such as ponderosa pine forests, oak shrub lands, montane grasslands, riparian, and wetland habitat (Shinneman et al.2000).

Recreational Uses

Every year, millions of people visit the public lands of the Southern Rockies for recreation. Many of them come at least in part to see wildlife, bringing significant tourist dollars to the region. Their presence helps the economy, but challenges wildlife managers.

Most outdoor recreationists in the Southern Rockies target one of the six National Parks and Monuments in the region, or one of the eight National Forests. Recreation on Bureau of Land Management land is on the rise, especially with the growth of ORV recreation, but it does not rival use of the parks and forests.

The most popular national forests in the region, measured in "recreation visitor days" (RVDs)[3], are the White River, Pike/San Isabel, and Santa Fe (Shinneman et al. 2000). The White River National Forest, recognized throughout the world for its exceptional outdoor recreation opportunities, ranked fifth in the nation in 1995 in terms of visitor days. Although the White River National Forest contains only 16% of the Forest Service lands in Colorado, it hosts about 30% of the state's national forest recreation (U.S. Forest Service 1999). Its 8,892 km^2 (3,473 mi^2) surround major ski resorts like Aspen, Vail, and Breckenridge, and provides 13% of all ski visits in the nation. Only 2-4 hours west of Denver on I-70, this national forest is the primary target of Front Range recreationists. The Front Range Pike/San Isabel area is popular for mountain bikers and backpackers. Many people visit the Santa Fe National Forest because of its close proximity to the urban areas of Santa Fe and Albuquerque (U. S. Forest Service 1999).

Data vary with respect to the number of annual visitor days estimated for each recreational activity. Bowker et al. (1999) predict higher rates of growth in user days for activities like cross country skiing (242%), downhill skiing, and backpacking, and slower rates for hunting (22%), fishing (59%), snowmobiling, and off road driving (54%). Not surprisingly, the overall patterns are similar for data concerning number of recreationists.

The biggest impacts associated with recreation in the Southern Rockies relate to the ski industry and the extensive land development associated with ski areas (*e.g.*, parking lots, second homes, condos, resorts, golf courses, and shopping centers). The ski areas themselves fragment high elevation forests with ski runs, chair lifts, and high mountain lodges. The recent expansion of Vail Resort Ski Area into lynx (*Lynx canadensis*) habitat in the White River National Forest provides an example of how controversial ski area impacts can be (Thompson and Halfpenny 1991). Even though 180 km^2 (70 mi^2) of the White River National Forest are currently under permit for skiing, the Forest Service is contemplating plans for expansion.

According to the Forest Service, Summit County, Colorado is growing rapidly and has the highest potential to provide additional capacity for skiing on National Forest lands. If growth rates stay the same, the combined daily capacity in 2010 must rise to 53,070 skiers a day to meet the projected demand of 5 million skiers per year. This will require an additional 5.7 km^2 (2.2 mi^2) of National Forest Lands. By 2030, the government estimates demand for skiing will require an additional 34 km^2 (13 mi^2), resulting in a total of 102 km^2 (40 mi^2) of National Forest land allocated to skiing in Summit County (U.S. Forest Service 1999).

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[3] Recreation visitor days are the total number of days each visitor used the national forest multiplied by the number of visitors. Thus, if a group of 10 people visited a national forest for 2 days, that would could as 20 recreation visitor days (10 people * 2 days).

Though studies do not project that mechanized recreation will grow as fast as downhill and cross-country skiing over the next 50 years, this activity still has a significant and growing presence on the landscape. In Colorado, the number of registered off-raod vehicles (ORVs) more than tripled during the 1990s, and snowmobile numbers increased by 64% (Finley 1999). ORV use on fragile desert lands and wetlands is of particular concern.

Even hiking and backpacking, seemingly low-impact activities, can produce negative ecological effects. Trails often traverse riparian areas and nesting areas and can harm native species and damage delicate natural communities. Heavy traffic in high elevation tundra causes damage that takes years to repair. The Colorado Fourteeners Initiative works throughout the state to improve trail systems and minimize human impact on fragile mountain ecosystems.

The main impacts associated with recreation on public lands in the Southern Rockies include direct disturbance of wildlife, modification of habitat through vegetation damage, introduction of exotic species, erosion, and air and water pollution (Knight 1995).

In sum, the best scientific and commercial data available indicates that human developments and their associated roads have a measurable and profound impact on wolves and their prey species. These effects can best be summarized as negative as related to habitat effectiveness for wolves, and should always be considered within the scope of project level decisions and cumulative impacts. In order to ensure that such cumulative impacts are considered is to designate critical habitat for the gray wolf in the Southern Rocky Mountains concurrently with the development of a regional recovery plan for the species.

Effects of Livestock Grazing

The contribution of ranching to the region's economy has been declining, but its effects on the land remain extensive and significant. Most ranchers in the Southern Rockies at least partially depend on public lands for grazing their animals. Typically, cattle and sheep spend summers on high elevation meadows in National Forests and are then often moved to lower elevation Bureau of Land Management rangelands in fall. Active grazing allotments exist on public lands throughout the region (Figure 4).

The U.S. Forest Service owns 70,740 km2 (27,633 mi2) in the ecoregion and nearly 70% of that has active grazing allotments. Likewise, the Bureau of Land Management grazes 93% of the 32,801 km2 (12,813 mi2) in Colorado. Of the 11,856 km2 (4,631 mi2) of state-owned land in Colorado, grazing occurs on roughly 80% (Shinneman et al. 2000). Similar figures exist for Bureau of Land Management and state land in the Wyoming and New Mexico portions of the ecoregion. In addition, all three National Wildlife Refuges in the region allow grazing on portions of their land. Given these numbers, Shinneman et al.(2000) estimate that livestock grazing is available on roughly 80% to 90% of state and federal public lands in the ecoregion, and grazing actually occurs on 70% to 80%.

Wilcove et al. (1998) estimated that livestock grazing contributed to the imperiled status of 33% of federally listed threatened species and 14% of endangered species. Since cattle preferentially congregate along stream banks and riparian areas, water quality and stream hydrology often suffers serious negative impacts (Schultz and Leininger 1990). Grazing can cause changes in plant species structure and composition (e.g., the proliferation of weeds like cheatgrass) that can lead to increased soil erosion (D'Antonio and Vitousek 1992). Indeed, rangeland managers have sometimes intentionally introduced non-native grasses, such as crested wheatgrass (*Agropyron desertorum*), because they provide good forage for livestock (Noss and Cooperrider 1994).

Grazing negatively affects some large ungulates, predators, and other native animals as well. Fences to control roaming livestock interfere with some animal movements, especially pronghorn antelope, but also deer and elk (Noss and Cooperrider 1994). Livestock compete with native herbivores for forage, water, and space, and livestock managers eliminate "pests" like prairie dogs (*Cynomys spp.*) and predators like coyotes (*Canis latrans*) (Peek and Dalke 1982). Federal and private efforts on behalf of the livestock industry eliminated wolves and grizzly bears in the Southern Rockies by the mid 1900s (Fitzgerald et al. 1994). The absence of these large carnivores has contributed to unnaturally large elk populations (Colorado Division of Wildlife 2001) throughout much of the Southern Rockies, which, in turn, has led to over-browsing of native vegetation, like aspen (*Populus spp.*), in some places (Baker et al. 1997).

The Forest Service and Bureau of Land Management have worked with livestock operators to improve the status of public rangelands and there has been some progress. However, of the 18,969 km2 (7,410 mi2) where the Bureau has determined rangeland trends, only 26% showed improvement in 1998.

In sum, livestock production within the relatively arid Southern Rocky Mountains negatively impacts the quality of habitat within the region. These effects are both direct (by increasing the risk of conflicts between wolves and livestock production), and indirect (via the cumulative negative effects of livestock grazing on habitat effectiveness for wild ungulates that provide the basis of a wolf economy).

FACTOR B. OVERUTILIZATION FOR COMMERCIAL, RECREATIONAL, SCIENTIFIC OR EDUCATIONAL PURPOSES.

The best scientific and commercial data available indicate that overutilization for commercial, recreational, scientific, or educational purposes may pose a threat to a future population of wolves in the Southern Rocky Mountains and could threaten the dispersal of wolves from the Northern Rocky Mountains to the Southern Rocky Mountains in the near-term. As discussed later in Factor D, human-caused mortality associated with management of delisted wolves in Wyoming could exceed sustainable levels.

Since listing under the ESA, no gray wolves have been legally killed or removed from the wild in the Northern Rocky Mountains for commercial, recreational, or educational purposes—a situation likely to maintain in the Southern Rocky Mountains so long as the species remains legally protected. In the Northern Rocky Mountains, approximately 3 percent of the wolves captured for scientific research, non-lethal control, and monitoring have been accidentally killed (http://www.fws.gov/mountain-prairie/species/mammals/wolf/archives.htm). Although some wolves may have been illegally killed for commercial use of the pelts and other parts, illegal commercial trafficking in wolf pelts or wolf parts is likely rare. Likewise, illegal capture of wolves for commercial breeding purposes likely extremely rare. The potential for prosecution provided for by the ESA has likely minimized the illegal killing of wolves for commercial or recreational purposes.

Scientific Research and Monitoring

Given that wolves are not extant in the Southern Rocky Mountains presently, the species in the region is not threatened by scientific research and monitoring. However, a future population would likely be subject to some level of monitoring, non-lethal control, and research purposes.

Education — A review of the literature failed to reveal that any wolves have been legally removed from the wild for solely educational purposes, anywhere in the lower forty-eight states. Wolves that are used for such purposes are usually the captive-reared offspring of wolves that were already in captivity for other reasons. However, States may get requests to place wolves that would otherwise be euthanized in captivity for research or educational purposes. Such requests have been, and will continue to be, rare; would be closely regulated by the State wildlife management agencies through the requirement for state permits for protected species; and would not substantially increase human-caused wolf mortality rates.

Commercial and Recreational Uses — Over 100 wolves were killed in the Northern Rocky Mountains between April and July 2008, after being delisted from the ESA (*Federal Register*: February 27, 2008 (Volume 73, Number 39)). Notably, as of the date of this petition, news reports quote the FWS as preparing to rescind the delisting rule for wolves in the Northern Rocky Mountains, pending court approval (as the rule was being contested in Federal court). Although it remains unclear if management of wolves will be returned to the state of Wyoming, this brief experience demonstrated that anything short of strict conservation protections for the species will likely prevent wolves from dispersing southward to Colorado.

FACTOR C. DISEASE OR PREDATION

Wolves face an assortment of bacterial, viral, fungal and parasitic diseases throughout their range. Several publications have provided extensive overviews of the known diseases that affect free-ranging wolves (Brand et al. 1995, Mech 1970, Mech & Boitani 2003), identifiying important diseases carried by wolves, including those that cause high numbers of infected animals (i.e., morbidity) and the number of animals that die of the disease (i.e., mortality).

Multiple publications have identified diseases affecting gray wolves in North America using necropsy, serological surveys, parasitic surveys, investigations into the factors affecting wolf health and illness, called epidemiological investigations, or incidental observations from case reports (Chapman 1978, Todd et al. 1981, Carbyn 1982). As a result of the naturally low densities of wolves, the large home range and distribution among packs within populations, and their relatively secretive nature, large die-offs from disease might go undetected unless specific populations are being intensively monitored (Brand et al. 1995). The risk of disease is an important consideration, as it relates to founder animals and release sites.

Wolves or other wildlife species run the risk of becoming infected by diseases from domestic species when their home ranges take them close to human habitation. In Denali National Park, Alaska, biologists have witnessed increased stress on wildlife populations due to domestic animal diseases and lice infestations (P. Owens, Denali National Park Research and Resources Division, pers. comm.). Canine parvovirus, canine distemper, and infectious canine hepatitis may have been transmitted to wild carnivores from the large domestic dog population (including sled dogs) outside the Park (Elton 1931, Stevenson et al. 1982). This could be a concern for wolves in the Southern Rockies.

Although viral agents (rabies, canine distemper, parvovirus), bacterial agents (tuberculosis), and parasites (sarcoptic mange) have caused mortality with possible declines in local populations (Davis et al. 1980, Carbyn 1982), there appears to be little evidence that any one disease has historically controlled wolf populations. The territorial nature of wolves with minimal mixing of individuals may limit losses to a pack or two, but spare most of the population. Many canine diseases originate from domestic sources and these pathogens may be less well adapted to wild hosts. The role of disease and parasites in controlling wolf populations remains relatively unknown. Several authors have suggested a relationship between disease and population density in other canid populations (Todd et al. 1981, Debbie 1991, Fekadu 1991). This has yet to be shown in wolf populations, however, it could become an important factor particularly in fragmented or island populations.

VI. PETITION FOR A RECOVERY PLAN & DESIGNATION OF CRITICAL HABITAT

STATUTORY REQUIREMENTS

Administrative Procedures Act (APA)

Pursuant to section 553 of the APA, Petitioners request that the Service prepare a recovery plan for the gray wolf in the Southern Rocky Mountains. Section 553 of the APA provides that "[e]ach agency shall give an interested person the right to petition for the issuance, amendment, or repeal of a rule." 5 U.S.C. § 553(e). The APA defines a rule as the whole or a part of an agency statement of general or particular applicability and future effect designed to implement, interpret, or prescribe law or policy or describing the organization, procedure, or practice requirements of an agency. 5 U.S.C. § 551(4). As such, a recovery clearly meets the definition of a rule under the APA.

Endangered Species Act (ESA)

In 1973 Congress passed the ESA to protect species at risk of extinction as a "consequence of economic growth and development untempered by adequate concern and conservation" (16 U.S.C. § 1531(a)(1)). Further, the ESA recognized the need to develop recovery plans in order to further the conservation of the species.

Development of a recovery plan and the designation of critical habitat for the gray wolf in the Southern Rocky Mountains will provide a means of protecting the ecosystems on which the wolf depends in this portion of its range (16 U.S.C. § 1533(f)(A)).

Once a species is listed under the ESA, the law intends for that species to be conserved. The term "conserve," along with "conserving" and "conservation," is defined under the ESA as,

> *…to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary (16 U.S.C. § 1532(3)).*

In other words, the ESA is successful when a species is recovered, i.e., it no longer faces imperilment or extinction. It is the duty of the Secretaries of the Interior and Commerce to implement the ESA pursuant to Department of the Interior (DOI) and Commerce findings and private citizen petitions (16 U.S.C. § 1533(a)). For the gray wolf, as this petition demonstrates, designation of critical habitat is imperative for obtaining the goal of recovery.

As Petitioners describe below, once a species is listed under the ESA, three sections of the ESA are central for imperiled species protection: critical habitat designation, protection from jeopardy, and recovery planning and implementation.

Critical habitat designation

The recovery of wolves in the Southern Rocky Mountains would be both enhanced and greatly expedited if the species is fully protected under the ESA, as it is entitled to critical habitat designation and protection of that critical habitat through consultation.

As outlined in Section V, wolves face a variety of threats to their survival. Of particular import are the anthropogenic threats associated with the production of livestock and the destruction or modification of habitat. It is the presence of these anthropogenic threats (and their critical role in fomenting the original imperilment of the species) that necessitate providing the species with the protections (including the designation of critical habitat) afforded under the "endangered" status.

Ongoing destruction and modification of the species' habitat also poses a long-term threat to the recovery and survival of the species throughout its range, including in the Southern Rocky Mountains. As demonstrated by Carroll et al. (2003, 2006), existing wolf habitat in the region faces serious threats by development. Conversely, habitat in the region could actually be improved by decreasing road densities on federal lands. *Ibid*. As Carroll et al. represents the best scientific and commercial data available with regard to wolf habitat in the Southern Rockies, the protection and restoration of habitat in the region is a clear priority as it relates to wolf recovery. Therefore, the protection of habitat duties conferred via the designation of critical habitat is both appropriate and necessary to affect the recovery of wolves in the Southern Rocky Mountains.

Designation of critical habitat for wolves in the Southern Rocky Mountains stands to enhance the efficacy of the recovery program, through the protective powers contained within the consultation process outlined by Section 7 of the ESA. In particular, federal actions within designated critical habitat must be scrutinized to determine if the proposed action would cause jeopardy to the listed species or adversely modify its critical habitat (50 C.F.R. § 402.14). After such a determination is made, the Service must provide the agency with a biological opinion explaining how the proposed action will affect the species or its habitat. If the Service concludes that the proposed action will jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat, the biological opinion must outline any "reasonable and prudent alternatives" that the Service believes will avoid that consequence (16 U.S.C. § 1536(b)(3)(A)).

FWS often finds that critical habitat designation would not benefit listed species, as the adverse modification prohibition in section 7 would not provide greater protection than the jeopardy standard, with its consultation requirement. This reasoning flies in the face of the actual construction of the ESA (Stanford Environmental Law Society 2000). Critical habitat protection is included in the ESA's mandate precisely because it does provide more protection. While Congress meant for listing protections and critical habitat protections to be determined on their individual merits, FWS often conflates the two and discards critical habitat as a necessary component of recovery. As Petitioners indicate below, the designation of critical habitat for wolves in the Southern Rocky Mountains would help to stem the degradation of habitat by human activities such development, road building and livestock grazing.

Indeed, the Fifth Circuit held that the Service's conflation of jeopardy and adverse modification in its regulations was invalid:

> …the Services' evaluation of the merits of critical habitat designation was premised on the view that jeopardy consultation was "functionally equivalent" to consultation under the destruction/adverse modification standard…This position was based on the fact that 50 C.F.R. § 402.02 defined both standards in terms of survival and recovery…As we have concluded that the regulatory definition of the destruction/adverse modification standard is flawed, this "functional equivalence" argument is untenable (Sierra Club v. U.S. Fish and Wildlife Service, 245 F.3d 434 (2001).).

Because FWS routinely refused to designate critical habitat and relegated critical habitat petitions to the lowest priority category, combined with remands from multiple courts concerned with the Service's neglect of critical habitat decisions and overuse of the "not prudent" determination, there is now a subset of listing funds specifically earmarked for critical habitat determinations (64 Fed. Reg. 57114-19 (October 22, 1999)).[4] It is important that critical habitat petitions not be neglected out of FWS policy denying the value of critical habitat. While listing is vital for a species to receive ESA protection, some conservation scientists argue that without the protection of a critical habitat the listing process is often nominal at best (*New Mexico Cattle Growers Assn. v. USFWS*, at 1284). As noted above, in *Sierra Club v. U.S. Fish and Wildlife Service*, the 5th Circuit found that critical habitat designation does in fact bolster the protection granted to a listed species; the 9th circuit has held similarly.

Critical habitat protection is enforced through Section 7 of the ESA, as is the prohibition on jeopardy of listed species. Section 7 prohibits any federal agency actions that are "likely to jeopardize the continued existence of any endangered species…"When critical habitat has been designated agency actions are not allowed to result in "the destruction or adverse modification of habitat of such species…" (16 U.S.C. §1536(a)(2))

<u>Clearly, wolves in the Southern Rockies would benefit from critical habitat designation</u>. With the safeguards provided by critical habitat designation, ecosystem services would continue to be furnished. Moreover, with the extensive public land within the wolf's range, federal lands could be a flagship for species and ecosystem recovery, which would be economically prudent. As clearly outlined in Section IV (Threats to the Species), wolves in the Southern Rocky Mountains face a variety of long-term challenges, including habitat loss through continued development on both private and public lands. Given the fact that over 60% of the Southern Rocky Mountains is in public ownership, the protective measures triggered by critical habitat designation for wolves in the region could result in significant benefit to the species, and the ecosystems upon which it depends.

Recovery Planning

The fourth component of the ESA's protection mandate is the recovery plan. When a species is listed as endangered the Secretary must develop and implement "plans for the conservation and recovery of [the species]" (16 U.S.C. § 1533(f)(1)). Given the fact that wolves remain extirpated from the Southern Rocky Mountains, despite notable population increases in the Northern Rocky Mountains, it is abundantly clear that recovery of wolves in the Southern Rocky Mountains will require the development and implementation of a recovery plan.

Section 4 of the ESA requires the Service to prepare a recovery plan for all endangered species and threatened species protected by the ESA. 16 U.S.C. 1533(f)(A). Recovery plans prepared under the ESA must contain the following elements:

(1) a description of site-specific management actions that may be necessary to achieve the plan's goal for the recovery of the species; (2) objective, measurable criteria which, when met, would result in an initial determination that delisting of the species may be appropriate; and (3) an estimate of the time required and cost to carry out those measures needed to achieve the plan's recovery goals.16 U.S.C. § 1533(f)(B). Unless the Service finds that preparing such a plan will not promote the conservation of the species, the obligation to prepare a recovery plan is mandatory. 16 U.S.C. § 1533(f). See also *Southwest Center for Biological Diversity v. Bartel*, 470 F. Supp.2d 1118 (S.D. Cal. 2006); *Environmental Defense Center v. United States Department of the Interior*, Case No. 99-9042, at 9 (C.D. Cal. May 20, 2001); *Sierra Club v. Lujan*, 1993 WL 151353, *11 (W.D. Tex. 1993).

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[4] Recent cases where courts have rejected the Service's "not prudent" finding include: *Sierra Club v. U.S. Fish and Wildlife Service*, 245 F.3d 434 (2001); and *Natural Resources Defense Council: Butte Environmental Council v. White*, 145 F.Supp.2d 1180 (2001).

Once prepared, recovery plans must be frequently reassessed by the Service. Section 4 requires the Service to report to Congress every two years on the status of efforts to develop and implement recovery plans for all species and explicitly contemplates that the Service will prepare revised recovery plans when necessary. 16 U.S.C. § 1533 (f)(3), (4). In fact, the ESA specifically provides that FWS shall provide public notice and an opportunity for public review and comment on any revised recovery plan prepared by the agency. 16 U.S.C. § 1533 (f)(4).[5]

BENEFITS OF A RECOVERED POPULATION OF WOLVES IN THE SOUTHERN ROCKY MOUNTAINS

Aldo Leopold (1966:190) wrote that, "The last word in ignorance is the man who says of an animal or plant: 'What good is it?' To keep every cog and wheel is the first precaution of intelligent tinkering." Despite this sage advice, the scythe of human-caused extinction cuts 1,000 to 10,000 times faster than historical background rates, and its pace is increasing (Wilson 2002). Yet, ecosystem health implies there are a full complement of native species as well as the biological processes associated with these species (i.e., structure and function).

Finely tuned interactions among species, physical environments, and ecological processes form the webs of life on our planet. Ecosystems, species, and systems have evolved over time within a range of variability (Noss 1999). When significant components of the system are lost or destroyed, that range may increase, exceeding species' ability to adapt. Unstable positive feedback can preclude a return to normal. Altered structure and function can then cause secondary waves of extinction that further amplify the instability.

Among animals, pollinators, seed-dispersers, ecosystem engineers (e.g., beavers), and a host of other organisms are critical to the structure and function of biological communities (Owen-Smith 1989, Wilson 1987, Buchmann and Nabhan 1996, Detling 1998). The presence of self-sustaining populations of gray wolves within their native range is indicative of the healthiest of ecosystems. When wolves are eliminated from the system, ecological and evolutionary relationships are distorted far beyond changed number and behavior of ungulates. Wolves perform important functions at and above the community level, whether through pathways of energy flow, through widespread coevolutionary adaptations with other organisms (e.g., prey species, mesopredators, parasites), or by affecting standing biomass and production. Accordingly, the restoration of an ecologically viable wolf population in the Southern Rocky Mountains should restore a significant level of ecological health to the region.

Large carnivores, including wolves, are important for far more than just their ecological value, however. For many people carnivores represent strong cultural, aesthetic, and existence values, and the importance of these values appears to be increasing (Kellert et al.1996). The strong values large carnivores invoke lead to substantial economic value, as more people spend money to see carnivores in the wild and purchase related products. Simply put, large carnivores matter to a vast and growing number of people.

How Carnivores Affect Ecosystem Health

One key goal of the ESA is to effect the recovery of threatened and endangered species and the ecosystems upon which they depend. 16 U.S.C. 1531 § (b). Perhaps nowhere else is the connection between individual species and ecological health more apparent than at the apex of the trophic system—a place often occupied by large carnivores, including wolves. Wolves are the apex carnivore in the systems they occupy (Ripple and Betscha 2003). When people discuss

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[5] Although there are no regulations governing the preparation and revision of recovery plans, the Service has prepared guidelines for the agency on recovery planning. See U.S. Fish and Wildlife Service, Policy and Guidelines for Planning and Coordinating Recovery of Endangered and Threatened Species (May 1990) (available at http://www.fws.gov/endangered/pdfs/Recovery/90guide.pdf).

ecological interactions that affect abundance, distribution, and diversity across trophic levels, they often talk about top-down or bottom-up control. In the ecological sense, control means a qualitative or quantitative effect on ecosystem structure, function, and diversity (Menge 1992).

Reducing trophic interactions to sharp categorizations of either top-down or bottom-up may be counterproductive. It is clear that forces flow in both directions simultaneously and interact while doing so (Menge and Sutherland 1976, Fretwell 1987, Hunter and Price 1992, Menge 1992, Power 1992, Estes et al. 2001). For example, while the number of trophic levels in a top-down cascade affects plant biomass, the productivity from the bottom-up also affects the number of trophic levels (Fretwell 1987, Power 1992). Scientists quickly recognized the qualitative and quantitative role that food has on consumers. Until recently, however, knowledge about how carnivores affect a system remained obscure.

As a simple example, if bottom-up control dominates, energy moving from lower to higher trophic levels regulates the system. An increase in the biomass of consumers is directly related to increases in productivity of their resources. Species richness and diversity are maintained by defenses of both plants and herbivores, or because competition forces species to specialize and use discreet niches (Pianka 1974, Hunter and Price 1992, Polis and Strong 1996). Because carnivores sit at the top of the food chain, bottom-up theories leave them with little ecological role (Estes et al. 2001). Under the bottom-up model, they receive more than they contribute. Implicitly, this can justify politically based management strategies that hold carnivore numbers artificially low (e.g., protecting domestic livestock or providing better opportunities for sport hunting).

In a system with top-down regulation, herbivores can reduce the biomass of plants, but in turn, carnivores check the growth of herbivore biomass (Hairston et al. 1960, Fretwell 1977, 1987, Oksanen et al. 1981, Oksanen and Oksanen 2000). Predation also produces indirect impacts that flow through the system far beyond the direct effect of a predator on prey (e.g., too few carnivores allow ungulate numbers to increase, which changes the plant community in ways that affect diversity, abundance, and competition among many other organisms). Top-down regulation implies strong interactions among three general trophic levels: plants, herbivores, and carnivores.

At very low levels of productivity, there will be only one trophic level: plants (see Oksanen and Oksanen 2000). Factors that limit plant biomass are available resources and competition with other plants for those resources. As productivity increases, so does plant biomass, until there is enough to support a second trophic level, the herbivorous consumers. *Id*. With two trophic levels, herbivore biomass increases with increasing productivity until a third trophic level can be supported, the carnivores. *Id*. Carnivores now limit the number of herbivores, reducing the amount of pressure that herbivores place on plants. The plants and carnivores now flourish (first and third trophic levels), whereas the herbivores (second trophic level) are held in check by carnivores.

Plants flourish under odd numbers of trophic levels, but growth is limited under even numbers. In contrast to bottom-up theory, under top-down regulation neither plant nor herbivore biomass increases linearly with increases in productivity. Instead, there will be a stepwise accrual as the food chain lengthens – herbivores limit the expansion of plants and carnivores do the same to herbivores. *Id*.

Sometimes a species with low biomass can have an ecological effect that is disproportionate to its abundance, a highly interactive species (Soulé et al. 2003, 2005). Under top-down regulation, the actions of these species maintain diversity, although a numerically dominant species may also serve that function (Paine 1966, Estes et al. 2001). If a carnivore checks a prey species that is competitively superior, or changes prey behavior in some way, then it is erecting ecological boundaries that protect weaker competitors from competitive exclusion (Paine 1966, Terborgh et al. 1999, Estes et al. 2001). Under this paradigm, carnivores play an important role in regulating interactions. Predation can cause indirect impacts that affect flora and fauna ecologically distant from the carnivore (Terborgh 1988).

The Impacts of Predators on Prey

As mentioned above, carnivores control prey by direct and indirect mechanisms. Predation may directly reduce numbers of prey (Terborgh 1988, Terborgh et al. 1997, 2001, Estes et al. 1998, Schoener and Spiller 1999). Indirect mechanisms cause prey to alter their behavior so that they become less vulnerable (Kotler et al. 1993, Brown et al. 1994, FitzGibbon and Lazarus 1995, Palomares and Delibes 1997, Schmitz 1998, Berger et al. 2001a). They may choose different habitats, different food sources, different group sizes, different time of activity, or limit the amount of time spent feeding.

If a predator selects from a wide-range of prey species, the presence of the predator may cause all prey species to reduce their respective niches and thus reduce competition among those species. Removing the predator will dissolve the ecological boundaries that check competition. As a result, prey species may compete for limited resources, and superior competitors may displace weaker competitors leading to less diversity through competitive exclusion (see Paine 1966, Terborgh et al. 1997, Henke and Bryant 1999). The impact of carnivores thus extends beyond the objects of their predation. By changing distribution, abundance, and behavior of herbivores, carnivores have far-reaching effects. Because herbivores eat seeds and plants, predation on that group influences the structure of the plant community (Terborgh 1988, Terborgh et al. 1997, 2001, Estes et al. 1998). The plant community, in turn, influences distribution, abundance, and competitive interaction within groups of birds, mammals, and insects.

As previously discussed, plants suffer or thrive when there are even or odd numbers of trophic levels, respectively. Direct evidence for this comes from the over-exploitation (fur trade) of sea otters (*Enhydra lutris*) in the north Pacific (see Estes 1996, Estes et al. 1978, 1989, 1998, Estes and Duggins 1995). This system evolved with three trophic levels: carnivorous sea otters, herbivorous macroinvertebrates (e.g., sea urchins), and kelp forest. Following sea otter decline, marine invertebrate herbivores increased in number and devastated the kelp forest (creating a system with two trophic levels). This produced a cascade of indirect effects that reduced diversity in a host of fish, shorebirds, invertebrates, and raptors (see Estes 1996, Estes et al. 1978, 1989, 1998, Estes and Duggins 1995).

Gradual recovery of the sea otter in recent years restored the third trophic level. Invertebrate grazers then declined, and the kelp forests and associated fauna recovered (Estes et al. 1978, 1989, 1998). When killer whales (*Orcinus orca*) entered the area, they imposed a fourth trophic level (Estes et al. 1998). The killer whales reduced numbers of sea otters, allowing the invertebrate grazers to increase and that reduced the biomass of the kelp forest.

Similarly, Krebs et al. (2001) synthesized 40 years of studies on the snowshoe hare (*Lepus americanus*) cycle. Some ecology textbooks have highlighted the observed 10-year oscillation as a predator-prey cycle between lynx (*Lynx canadensis*) and hare. The Krebs et al. (1995, 2001) study, however, revealed that one can only understand the process by analyzing all three trophic levels. To quote Krebs et al. (2001: 34), "The hare cycle is caused by an interaction between predation and food supplies, and its biological impacts ripple across many species of predators and prey in the boreal forest." When examining these interactions Krebs et al. (2001) stated that the dominant factor regulating the hare cycle was predation. Cycle dynamics did not change with the addition of nutrients, and the immediate cause of death in 95% of the hares was predation. Furthermore, lynx were not the only predator of hares. Lynx, coyotes (*Canis latrans*), goshawks (*Accipiter gentilis*), great-horned owls (*Bubo virginianus*), smaller raptors, and small mammals, particularly red squirrels (*Tamiasciurus hudsonicus*) and ground squirrels (Krebs et al. 2001) all killed snowshoe hares. Absent lynx, the hare cycle continued unchanged because of compensation (Stenseth et al. 1998).

In the Neotropics, Terborgh et al. (1997, 2001) took advantage of a hydroelectric project that recently formed Lago Guri in Venezuela. The lake is 120 kilometers long and up to 70 kilometers wide with islands scattered throughout. After seven years of isolation, nearly 75% of the vertebrate species have disappeared from the islands that are too small to hold jaguars (*Panthera onca*) and pumas (*Puma concolor*) (Terborgh et al. 1997, 2001). The few species that remain are hyper-abundant with devastating effects on the plant community. On these islands there is little regeneration of the canopy trees (Terborgh et al. 1997, 2001).

In another example, researchers working on grasslands in Texas found that 9 months after coyote removal, rodent species richness and diversity declined compared to areas with coyotes (Henke and Bryant 1999). Twelve months after coyote removal, the Ord's kangaroo rat (*Dipodomys ordii*) was the only rodent species captured on the treated grassland (*Ibid*.). The removal of coyotes eliminated the ecological boundaries among species of rodents, and the Ord's kangeroo rat was a superior competitor. They increased in number and displaced other species.

Wolves are a highly interactive species. Long-term monitoring data from the boreal forest of Isle Royale indicate that predation by wolves on moose (*Alces alces*) plays a role in ecosystem function by changing the number and behavior of moose (McLaren and Peterson 1994). The number and movements of moose then affects the balsam fir (*Abies balsamea*) forest (and other woody plants) by regulating seedling establishment, sapling recruitment, sapling growth rates, litter production in the forest, and soil nutrient dynamics (Pastor et al. 1988, Post et al. 1999 and references within). When the wolf population declined for any reason, moose reached high densities and suppressed fir growth. This top-down "trophic cascade" regulation is apparently replaced by bottom-up influences only when stand-replacing disturbances such as fire or large windstorms occur at times when moose density is already low (McLaren and Peterson 1994). This is strong evidence that wolves exert top-down control of a food chain.

Research elsewhere suggests elk (*Cervus elephus*) populations not regulated by large predators negatively affect the growth of aspen (*Populus tremuloides*) (Kay 1990, Kay and Wagner 1994). Wolves, a significant predator of elk, may positively influence the aspen canopy through a trophic cascade caused by reducing elk numbers, modifying elk movement, and changing elk browsing patterns on young aspen (White et al. 1998; Ripple and Betscha 2003; 2004). Aspen recruitment ceased when wolves disappeared from YNP (Ripple and Larsen 2000). Similarly, Berger et al. (2001b) showed that moose increase their numbers, when wolves and grizzly bears (*Ursus arctos*) were absent. Because moose reduce the quality and quantity of willow, neotropical migrant birds fare better in areas where wolves and bears prey on moose. These factors are being reversed with the reintroduction of wolves into Yellowstone in 1995 (Ripple and Betscha 2004).

Relationships Between Large Carnivores and Mesopredators

Large carnivores directly and indirectly affect smaller predators, and therefore the community structure of small prey (Terborgh and Winter 1980, Soulé et al. 1988, Bolger et al. 1991, Vickery et al. 1994, Palomares et al. 1995, Sovada et al. 1995, Crooks and Soulé 1999, Henke and Bryant 1999, Schoener and Spiller 1999). Small prey distribution and abundance affect ecological factors like seed dispersal, soil porosity, soil chemistry, plant biomass, plant nutrient content, and epizootics (Whicker and Detling 1988, Hoogland 1995, Detling 1998, Keesing 2000).

In California, Soulé et al. (1988) and Crooks and Soulé (1999) documented more species of scrub-dependent birds in canyons with coyotes than in canyons without coyotes. The absence of coyotes allowed behavioral release of opossums (*Didelphis virginianus*), foxes (*Vulpes spp.*), and house cats. These species preyed heavily on songbirds and native rodents. Researchers have also observed the effects of mesopredator release in grasslands (Vickery et al. 1994, Henke and Bryant 1999), wetlands (Sovada et al. 1995), and Mediterranean forest (Palomares et al. 1995).

Mesopredator release can manifest in at least three ways: population increases of mesopredators, modified niche exploitation, and altered community structure (largely because of the first two). An excellent example comes from Yellowstone. Wolves were extirpated from the Park in the early part of the last century. In the absence of competition from wolves, coyotes assumed some of the ecological characteristics and functions of the larger canid, including pack formation and predation on large ungulates (Crabtree pers. comm.). However, due to physical limitations, coyotes could only partially fill the role of the apex predator. The dynamics of the predator/prey system were modified. Interspecific associations such as mutualistic relationships and/or co-evolved food webs were disrupted. This in turn may have markedly altered the diversity and composition of the natural community, causing secondary extinctions or other unanticipated ripple effects.

When wolves were reintroduced, they changed the distribution and abundance of competitors such as coyotes, as they have done elsewhere (Paquet 1989, 1991, 1992, Crabtree and Shelton 1999). In addition to these obvious competitive interactions, wolves also provide a regular supply of carrion, which is exploited by smaller carnivores.

Macroecological Evidence for Top-down Forces

The previous sections outlined some mechanisms through which carnivores can control ecosystems. How widespread are these impacts? Historically, many managers and biologists held the view that bottom-up forces drove ecosystem interactions. That viewpoint persists today (see Polis and Strong 1996). Obviously, resource abundance and competition play important roles, but modern evidence shows that top-down effects function simultaneously (see Terborgh et al. 1999, Estes et al. 2001). To ignore the indirect effects that carnivores exert on diversity, structure, and function of an ecosystem could fatally flaw management strategies.

There is a growing body of macroecological evidence to support the impact of carnivores on ecosystems. For example, Oksanen and Oksanen (2000) compared areas with herbivores to areas without herbivores to determine differences in plant biomass and primary productivity. All 51 locations studied were in Arctic/Antarctic regions. In areas with herbivores, the regression slope between plant biomass and increasing productivity was flat, whereas in areas without herbivores the regression slope between plant biomass and increasing productivity was positive and steep. *Id*. This supports their hypothesis of top-down regulation. Wolves are the apex carnivore in the systems they occupy (Ripple et al. 2003), and the evidence from YNP and elsewhere indicates that wolves do, in fact, have a top-down regulatory effect (White et al. 1998; Ripple and Betscha 2003; 2004), as discussed previously.

Outside the Arctic/Antarctic, most macroecological evidence for impact of carnivores on ecosystems must be viewed with caution because humans already have altered a large percentage of temperate and tropical biomes. This complicates our ability to separate the effects of carnivores from those of humans. Nevertheless, evidence suggests that carnivores are important.

Crête and Manseau (1996) compared the biomass of ungulates to primary productivity along a 1,000 km latitudinal gradient on the Québec-Labrador peninsula, and Crête (1999) did the same over North America. For the same latitude, ungulate biomass was 5 to 7 times higher in areas where wolves were absent compared to where wolves were present. In areas of former wolf range, but where currently no wolves exist, a regression of ungulate biomass to primary productivity produced a positive slope (Crête 1999), indicating that the absence of wolf predation had released ungulate herbivory to a significant degree. In Poland, red deer (elk) irrupted after persecution eliminated wolves, and roe deer (*Capreolus capreolus*) irrupted when humans extirpated European lynx (*Lynx lynx*) (Jedrzejewska and Jedrzejewski 1998 in Jedrzejewski et al. 2002). The elimination of carnivores from an area that evolved with strong predator–prey interactions may have a severe impact through a trophic cascade.

Having considered both qualitative and quantitative evidence, Terborgh et al. (1999) concluded that top-down control was stronger and more common than previously thought. Schmitz et al. (2000) conducted a quantitative meta-analysis of trophic cascades in terrestrial systems using data from 60 independent tests in 41 studies. Their analysis, limited to invertebrates and small vertebrates, detected trophic cascades in 45 of the 60 tests. They showed that predator removal had a significant direct impact on herbivore numbers and on plant damage (positive), and reduced plant biomass and plant-reproductive output (negative). Schmitz et al. (2000) concluded that trophic cascades were present under a variety of conditions with different types of predators, and occurred more frequently than currently believed.

Another quantitative meta-analysis examined 40 scientific papers on terrestrial trophic cascades in arthropod-dominated food webs (Halaj and Wise 2001). They reported extensive evidence supporting terrestrial trophic cascades. Indeed, 77% of the 299 experiments showed a positive response on the part of herbivores when predators were removed (*Ibid*.).

Finally, Estes et al. (2001) reviewed the impacts of predation from a variety of different ecosystems, including rocky shores, kelp forests, lakes, rivers/streams, oceanic systems, boreal/temperate forests, coastal scrub, tropical forests, and exotic predators on islands. They concluded that the process of predation has dramatic impacts at organizational levels ranging from individual behavior to system dynamics, and on time scales that range from ecological to evolutionary (Estes et al. 2001).

Failing to recognize the role of carnivores can produce drastic changes in ecosystems. For example, managers have reduced carnivore numbers to keep ungulates at artificially high levels for recreational hunting. Yet, overabundance of white-tailed deer has been shown to reduce numbers of native rodent species, produce declines in understory nesting birds, obliterate understory vegetation in some forests, and even eliminate regeneration of the oak (*Quercus spp.*) canopy (Alverson et al. 1988, McShea and Rappole 1992, McShea et al. 1997).

Relative Strength of Interactions under Various Conditions

While carnivores like wolves exert top-down influences on communities, those influences vary significantly under different environmental conditions. The level of influence is a complex and situational event. Abiotic factors, such as type, frequency, and scale of natural disturbance (see Connell 1978) can influence the relative importance of top-down or bottom-up forces. Disturbance over large geographic scales shortens food chains (at least temporarily) and thus changes interaction dynamics among trophic levels (Menge and Sutherland 1976). Climatic patterns, such as El Niño or La Niña affect the ability of highly interactive predators to regulate prey in aquatic (Sanford 1999) and terrestrial systems (Ballard and Van Ballenberghe 1997, Post et al. 1999). Seasonally driven mechanisms can alter rates of compensatory mortality and natality, and thus adjust the impact of predation on the population size of prey (Boyce et al. 1999). The level of productivity in a region can influence what threshold of distribution and abundance for the predator allows that predator to exert its role in ecosystem function.

Behaviors like migration allow animals to make use of food over a larger area (Fryxell et al. 1988). If terrestrial predators are unable to follow migrating ungulates over a long distance, then they will have less relative impact on population numbers of the migrants (Fryxell et al. 1988, Fryxell 1995). Migratory wildebeests (*Connochaetes taurinus*) fit the hypothesis of predation-sensitive foraging, where both food supplies and predation interact to regulate populations (Sinclair and Arcese 1995). Like the earlier example of snowshoe hares, predation is the final agent of mortality. Unlike the case of the hares, however, food supply plays a driving role in mortality of wildebeests by predation. As food supply decreases, wildebeests increase their risk to find food (*Ibid*.).

The physical habitat in which an animal lives imposes adaptive pressures that mold behaviors and population structures, in turn affecting the role of predation. Behavior of the predator is important. Is it social or solitary? Is it a cursorial or "sit-and-wait" hunter? Is it a generalist or specialist? In the prey, sociality and large body size enhance avoidance capabilities.

The strength of interaction is complex and situational. Even within the same species, it can be difficult to extrapolate results from one part of the range to another (Soulé et al. 2003; 2005).

Carnivores and Management

Scientific data increasingly indicate that carnivores play an important controlling role in an ecological system (see Terborgh et al. 1999). Yet, carnivore control as institutionalized by several government agencies, has historically been the center of our management solutions. Intensive management regimes often do not fully consider the circumstance, season, behavior, or other conditions that affect the complex role of carnivores in the system.

Short-term control and hunting restrictions may be necessary when a system is highly perturbed or fluctuating outside its normal bounds of variability. Just as heavy human harvest can influence prey numbers, so too can predators, particularly when prey densities are low (Boyce et al. 1999). However, rather than focusing solely on symptoms, one should ask deeper questions about why ecosystems are perturbed. What indirect effects ripple through a system if managers or hunters reduce carnivore numbers below the bounds of their natural variation? What will happen to vegetation and non-game species diversity if managers try to hold ungulate numbers at unnaturally constant and high numbers for recreational hunting? Can populations of predator and prey be managed in ways that more closely resemble natural patterns? (Indeed, management of ungulate production for hunter success philosophically differs little from livestock management for meat production.) The quote in Ballard et al. (2001: 107) is telling:

> Biologists continue to debate whether predation is a regulatory or a limiting factor, but to wildlife managers who are responsible for managing deer populations to provide hunting and viewing opportunities, the distinction between these terms may not matter.

It should. The evidence indicates that our lack of understanding (or lack of caring) about the role of carnivores in ecosystem processes has damaged those ecosystems. Carnivore eradication and reduction has simplified systems and reduced biodiversity, largely by eliminating their keystone role of ungulate predation.

Not only have wildlife managers reduced carnivore numbers, they have managed for unnaturally high numbers of ungulates. The elk population in the state of Colorado currently exceeds the carrying capacity of the range. In 2001, CDOW wanted to reduce elk numbers from about 260,000 to 190,000 (Meyers 2001). After an elk count showed that numbers had swelled to 305,000 in the spring of 2002, the Division of Wildlife raised its target population to 230,000. Adjusting target goals after the fact does not change productivity of the land (the winter of 2001/2002 was very dry).

In short, management policies based on reducing carnivore numbers have caused, and will continue to cause, severe harm to many other organisms that seem distantly removed from the apex trophic layer (see Terborgh 1988; Terborgh et al. 1999). For these reasons, carnivore policy and ungulate management must be driven by sound ecological science at the landscape scale.

Importance of Large Carnivores to People

Nature and the wildlife it contains provide physical, emotional, and intellectual benefits to people Kellert 1996, Decker et al. 2001). Large carnivores epitomize the so-called charismatic megafauna (i.e., large, charismatic species) that tend to enjoy greater support among most people (Kellert 1996). People appreciate large carnivores for the cultural, aesthetic, existence, economic, and other values they represent (Kellert 1995, 1996). Other people distain large carnivores based on fears for human, livestock, or pet safety; the economic impact they sometimes cause or are perceived to cause; and issues of private property rights and government actions that they believe large carnivores represent (Kellert 1995, Meadow et al. 2005).

The significance of some species from an historical or other human-centered perspective leads to strong personal and symbolic values (Shepard 1978, Kellert 1986, 1996, Reading 1993). Large carnivores provide symbolic, religious, and historical values to many people (Rolston 1985, Hardy-Short and Short 2000). These animals often invoke a feeling of awe and enlivened senses among humans (Kellert 1996, Hardy-Short and Short 2000). As a result, in many cultures, people revere or revered large carnivores (Lukert 1975, Campbell 1988, Nelson 1993). Hoping to tap into the admired attributes of large carnivores, such as hunting prowess, stealth, strength, and speed, people created religious and social societies centered on the these animals (Levi-Strauss 1963, 1966, Campbell 1988). Large carnivores continue to symbolize such traits today, as any list of sports teams' and luxury products' names attest.

The beauty and symbolic nature of large carnivores inspires many people (Kellert 1995, Kellert et al. 1996). That inspiration often stimulates the mind and results in an artistic outpouring (Van Dieren and Hummelinck 1979, Rolston 1981, Reading 1993). As a result, large carnivores often form the foci of literature, poems, paintings, sculptures, and dance. These animals—and the art they inspire—provide a source of satisfaction, well-being, and contentment to many people who view them (Kellert 1995).

People also develop strong emotional attachments to large carnivores based on moral and ethical considerations (Kellert 1980, 1996, Reading 1993). Many of these people will never see a large carnivore in the wild, but they want these animals to exist. To these people, such intrinsic, "existence values" are important and influential (Rolston 1981, Brown et al. 2001). People donate substantial sums of money to ensure the conservation of large carnivores and often vote to further their protection. To some of these people, large carnivores are not only important to them, but they want to ensure that their children or grandchildren have the opportunity to see them in wild. Social scientists dub these 'bequest values' (Brown et al. 2001). Other people embrace 'altruistic values' toward carnivores – they simply recognize that other people want to see large carnivores, whether or not they are related to them.

Large carnivores head the list of species people want to see when they engage in wildlife-based recreation, and they often expend great effort in trying to catch a glimpse of large carnivores in natural settings (Van Dieren and Hummelinck 1979, Rolston 1981, Reading 1993). As a result of the satisfaction many people obtain from direct experiences with large carnivores, they spend money traveling to view and purchasing products that feature these animals (Kellert 1996). Large carnivores also add value to outdoor recreation that is not wildlife-based, as people often place additional value on seeing large carnivores or simply knowing these species are around them (Rolston 1981, Shaw 1987, Brown et al. 2001). The economic impact of wolf restoration to YNP, for example, generates an additional $35 million/year in revenue for the region surrounding the park; and, since those dollars turn over in the local communities, the wolves have created an overall impact of $70 million/year to the local economy (Duffield et al. 2006, Stark 2006). Indirect recreational values accrue from books, television shows, and magazines devoted to these animals (Bryan 1980, Kellert et al. 1996). Large carnivores help companies sell many other products from cars to corn flakes to camping gear to tickets to sporting events.

Not all of the values ascribed to large carnivores are positive, however. Some people dislike large carnivores because they pose or are perceived to pose a threat to the safety of humans, pets or livestock (Kellert 1980, 1995, Reading 1993, Hardy-Short and Short 2000). Yet, that dislike often extends well beyond concerns for safety. As Kellert et al. (1996: 105) stated with respect to wolves:

> As the extent and viciousness of the killing often reached irrational proportions, one suspects the wolf may have performed roles beyond the merely utilitarian. Destroying the wolf may have also reflected the urge to rid the world of an unwanted and feared element in nature, perhaps even the settler's atavistic potential to succumb to the allure of wildness and the absence of civilizing control.

Kellert et al. (1996: 110) goes on to suggest that for some people "the wolf, grizzly bear, mountain lion, and other large predators remain a vivid reminder of the necessity to combat and repress wild nature in the never ending struggle to render the land safe and productive." To other people large carnivores have come to symbolize governmental interference in how they manage private property or interact with wildlife (Kellert et al. 1996, Meadow et al. 2005). For centuries, governments helped people in their efforts to control or eradicate large carnivores (Lopez 1978, Dunlap 1988, Kellert et al. 1996), so it is not surprising that the recent shift by many government agencies from control to conservation has been met with bewilderment and anger by some sectors of society.

Despite some of the negative values they engender, overall, large carnivores stimulate the imagination and inspire a sense of awe and wonder for many people, making them among the most highly valued of all species. It is difficult to place a monetary figure on many of the values ascribed to large carnivores (Brown et al. 2001). The result is that large carnivores often go underappreciated in traditional economic analyses and therefore governmental policies. Yet, that is slowly changing as decision makers increasingly recognize that not all parts of a cost-benefit analysis are easily captured using traditional methods (Brown et al. 2001, Loomis 2004).

In sum, large carnivores are ecologically important, often disproportionately important, to the ecological systems they inhabit. Yet, they are also important to people for a variety of other reasons, including cultural reasons, aesthetics, their right to exist, and for the economic benefits they sometimes accrue. Large carnivores often exert strong influence on ecological systems through top-down regulation, in which they affect herbivores that in turn affect the vegetation. The mechanisms of top-down regulation include both direct affects, through predation, and indirect affects, in which large carnivore influence the behavior of their prey. By controlling population of smaller predators, large carnivores also reduce pressure on the prey of these mesopredators. Evidence for the importance of large carnivores to the ecological systems they inhabit continues to mount. Many people value the role that these charismatic animals play in the systems they inhabit, but people value large carnivores for a wide variety of other reasons as well, including symbolic, existence, aesthetic, recreational, and other values. Of course, many people also hold negative values and attitudes toward large carnivores. Thus, the human dimensions of large carnivore management often rival or surpass the ecological challenges of management.

Potential for Recovery in the Southern Rocky Mountains

The best scientific and commercial data available indicates that the Southern Rocky Mountains region has a significant capacity to support and sustain a population of gray wolves (Bennett 1994; Carrol et al. 2003). As early as 1994, scientific information painted the Southern Rockies as a great habitat for wolves. Bennett (1994), working with the FWS and the University of Wyoming Cooperative Research Unit, estimated that western Colorado could support around 500 to 1,000 wolves. Martin et al. (1999) found areas that were highly suitable for wolves in northwestern, west-central, and southwestern Colorado, and they agreed with the estimates by Bennett (1994).

A Population and Habitat Viability Analysis (PHVA) conducted by the International Union for the Conservation of Nature (IUCN) bolstered the predictions of these earlier models (Phillips et al. 2000). Martin et al. (1999) and Carroll et al. (2003) identified areas in northwestern, west-central, and southwestern Colorado where wolves could thrive. In addition, they noted good wolf habitat at the Colorado-Wyoming border and in northern New Mexico (Carroll et al. 2003). Carroll et al. (2003) predicted that perhaps 1,300 wolves could eventually live in the Southern Rockies, with nearly 90% of those wolves using public land. The Southern Rockies Ecosystem Project's Southern Rockies Ecosystem Vision (Miller et al. 2003) outlined a plan to retain and enhance connectivity for wolves among these areas, largely using least-cost path analysis[6] (Fink et al. 2003).

Carroll et al. (2003, 2006) further estimated the success of reintroducing wolves to four core areas of 2,500 km2 of high-quality habitat (see Figure 5). They predicted that 97 wolves could inhabit a northern New Mexico/south-central Colorado core area (the Carson National Forest, Santa Fe National Forest [NF], Vermejo Park Ranch); 75 wolves could live in a southwestern Colorado core area that is probably the wildest area in the Southern Rockies (the San Juan NF, Rio Grande NF, and Grand Mesa, Uncompahgre, and Gunnison NF); 102 wolves could exist in a west-central Colorado core area (northern portions of the Grand Mesa, Uncompahgre, and Gunnison NF, and the southern portion of the White River NF); and 155 wolves could reside in a northwestern Colorado core area (the Flattops, encompassing portions of the White River NF and Routt NF). Eventually some wolves would disperse from these core areas and promote growth of the population throughout the ecoregion and beyond.

The best scientific and commercial data available indicates that wolves are not likely to successfully recolonize the Southern Rocky Mountains through natural immigration (Carroll et al. 2003). Specifically, Carroll et al. (2003) considered the likelihood of wolves inhabiting the Southern Rockies Ecoregion from dispersers arriving from Wyoming, concluding that such movements would produce less than one pack in the Southern Rockies over 200 years. Since then, it has become clear that the state of Wyoming will manage wolves aggressively to minimize

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[6] Least-cost path analysis utilizes route-finding algorithms that have some applicability to the way that animals may move through the environment in order to find potential habitat connections between core areas. Computer simulations like these are only the first step in identifying corridors for animal movements. For more information, see: http://www.grizzlybear.org/leastcostpath.htm as an example of an application to carnivores.

the size of the population there, including the number of dispersing wolves. While it seems appropriate for CDOW to adopt a management plan that promoted the survival of wolves dispersing from Wyoming, it further seems certain that reintroducing wolves to core areas of high-quality habitat is the most certain and cost-effective way to restore the species to the Southern Rockies Ecoregion.

The message from the models of Martin et al. (1999), Bennett (1994), Phillips et al. (2001), and Carroll et al. (2003, 2006) is that the Southern Rockies ecoregion could support a viable population of around 1,000 wolves under current landscape conditions. Those wolves would largely inhabit public lands and genetic exchange would occur among populations. While the social structure of wolves hastened their decline a century ago, that same social structure can help wolves restore themselves quickly, as evidenced by the results in YNP (Smith and Ferguson 2005).

Wolves may leave protected areas, but populations will remain dependent on those protected cores areas (Fritts and Carbyn 1995, Haight et al. 1998, Woodruffe and Ginsberg 1998). Even though elk numbers in the southern Rockies rivals prey availability in the Greater Yellowstone Ecosystem, the smaller size of protected areas in the Southern Rockies means humans may kill more wolves as they move throughout the region. That could slow the rate of wolf establishment in the Southern Rockies. While wolf recovery efforts in the Great Lakes region of the United States suggest that wolves can coexist with high levels of development, people there have lived with wolves for several decades. Wolf reintroduction to the western U.S. likely faces heavy initial resistance. Other factors, such as state's rights, concerns over possible restrictions from implementation of the ESA, and fear of change undoubtedly will all come into play. It may take years to alter such perceptions. After a decade, the Mexican wolf reintroduction still falters due to human resistance and lack of a core protected area. As such, reintroduction remains the most likely path to successful recovery of the species in the Southern Rocky Mountains within a reasonable timeframe, given the ability of managers to quickly create a large, diverse population of founders.

The small size and relative isolation of core areas in the Southern Rockies Ecoregion means connectivity among populations will remain important (Haight et al. 1998). The Southern Rockies Ecosystem Vision outlines a plan to retain and enhance such connectivity (Miller et al. 2003). Combined with proposed reintroductions into the Grand Canyon area, which enjoys the largest potential for wolves in the Southwestern U.S. (Carroll et al. 2006), reintroducing wolves into the Southern Rockies provides an outstanding opportunity to help recover the animal throughout a significant portion of its range—as mandated by the ESA. These two proposed reintroductions would reconnect wolves along the Spine of the Continent—the Rocky Mountain chain—from Mexico through Canada and beyond. Noted wolf biologist Dr. L. D. Mech concluded the following when considering wolf restoration to the Southern Rockies ecoregion:

> "Ultimately then this restoration could connect the entire North American wolf population from Minnesota, Wisconsin, and Michigan through Canada and Alaska, down the Rocky Mountains into Mexico. It would be difficult to overestimate the biological and conservation value of this achievement."

Reintroduction to these two areas would also restore a linkage for wolves along the Colorado River, thus connecting two extremely popular National Parks—Grand Canyon and Rocky Mountain National Parks (as well as the several parks between them). Sufficient habitat and prey for wolves exist in these regions now. Evolutionary and ecological restoration will not occur if wolf recovery is limited to a few small and isolated populations in the northern Rockies, north central U.S., and southwestern U.S., all of which will come to more closely resemble museum pieces rather than functioning ecological and evolutionary processes (see Soulé et al. 2003, 2005).

REINTRODUCTION AS A RECOVERY MECHANISM

As discussed previously, the best scientific and commercial data available indicate that natural recolonization is not likely to result in the recovery of wolves in the Southern Rocky Mountains (Carroll, et al. 2003). Given this conclusion, a recovery plan for wolves in the Southern Rocky Mountains must include reintroduction of wolves to the Southern Rockies.

Legal Considerations

Endangered species may be reintroduced to parts of their range under various different legal scenarios. First, they may be reintroduced as fully protected species (i.e. "endangered"). As has been done in the Northern Rocky Mountains, wolves may be reintroduced as an "experimental" population under section 10(j) of the ESA. Or, finally, wolves may be repatriated under scenarios that utilize aspects of the ESA meant to enhance recovery of the species, such as Safe Harbor Agreements or Enhancement of Survival permits.

Petitioners here argue that wolves in the Southern Rocky Mountains shall be reintroduced to their former range with the full protections of the ESA in place. Although this has not been the chosen alternative for restoration of wolves heretofore, it remains the most biologically and legally justifiable means to accomplish recovery of the species. In particular, recovery of this fecund habitat generalist would be both enhanced and greatly expedited if the species is fully protected under the ESA it, because it is entitled to critical habitat designation and protection of that critical habitat through consultation.

As outlined in Section V, the species faces a variety of threats to its survival. Of particular import are the anthropogenic threats associated with the production of livestock and the destruction or modification of habitat. It is the presence of these anthropogenic threats (and their critical role in fomenting the original imperilment of the species) that necessitate providing the species with the protections (including the designation of critical habitat) afforded under the "endangered" status.

As has been demonstrated with previous and current wolf recovery efforts elsewhere, authorized take of wolves listed as experimental non-essential has exacted a significant toll on the recovering wolf populations. By contrast, were the species afforded the full protections of the law, the incidence of take would be expected to be substantially diminished. Moreover, research to-date has failed to demonstrate long term efficacy of control actions in reducing the incidence of depredations (Musiani, et al. 2003), and the Service has yet to provide any evidence that aggressive control actions increase tolerance for the species amongst livestock producers. Given that aggressive control of depredating wolves has failed to demonstrate efficacy on any measure tied to the long term conservation of the species, the Service is left with no justification for reducing legal status of the species. That is a very good point

Ongoing destruction and modification of the species' habitat also poses a long term threat to the recovery and survival of the species throughout its range, including in the Southern Rocky Mountains. As demonstrated by Carroll, et al. (2003, 2006), existing wolf habitat in the region faces serious threats by development. Conversely, habitat in the region could actually be improved by decreasing road densities on federal lands. *Ibid*. As Carroll, et al. represents the best scientific and commercial data available with regard to wolf habitat in the Southern Rockies, the protection and restoration of habitat in the region is a clear priority as it relates to wolf recovery. Therefore, the protection of habitat duties conferred via the designation of critical habitat is both appropriate and necessary to affect the recovery of wolves in the Southern Rocky Mountains. Designation of critical habitat for wolves in the Southern Rocky Mountains stands to enhance the efficacy of the recovery program.

Other reintroduction programs have been effectively conducted under the protections of a fully endangered status for the listed species. In particular, the California Condor (*Gymnogyps californianus*) has been reintroduced in California under an endangered classification, and the American peregrine falcon (*Falco peregrinus anatum*) was successfully recovered and removed under the act, in part as a result of reintroduction efforts conducted with the species listed a endangered.

In sum, it is both appropriate and possible to successfully recover wolves using reintroduction while maintaining full legal protection for the species. Maintaining status of the species as endangered would, arguably, help to expedite recovery and reduce program expense through cost avoidance.

VII. CONCLUSION

For the reasons set forth above, Petitioners request that FWS develop a recovery plan for gray wolves in the Southern Rocky Mountains and designate critical habitat for the species in the region. Petitioners expect timely processing of this petition. A recovery plan and critical habitat for wolves in the Southern Rockies is warranted due to the present absence of the species from this part of its historic range and the determination of the best scientific and commercial data available that the region could support over 1,000 wolves, and that under certain habitat scenarios in the future the capacity of the region to support wolves could be diminished without adequate protection.

The extirpation of the gray wolf from the Southern Rockies stands as a symbol of the "consequences of economic growth and development untempered by adequate concern and conservation" (ESA Section 2; 16 U.S.C. § 1531(a)(1)). The protection and restoration of the Southern Rocky Mountains and this important apex predator is therefore mandated under the ESA.

Respectfully submitted,

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