Mexican Wolf Conservation Assessment

U.S. Fish and Wildlife Service
Southwest Region (Region 2)
Albuquerque, New Mexico
2010

Disclaimer

Data from the Mexican Wolf Blue Range Reintroduction Project used in this document spans from 1998 to December 31, 2009, or for a range of years within this time period. Some of the data are only available in published form in annual reports, and thus reported only through December 31, 2008.

Acknowledgments

The Mexican Wolf Conservation Assessment is dedicated to John Raymond Morgart, Ph.D. John passed away on October 14, 2009, at the age of 58. He led the Mexican wolf recovery program from 2004 to 2008 with enormous dedication and skill. His many contributions to the conservation of the Mexican wolf, including this document, are remembered with great gratitude.

The following U.S. Fish and Wildlife Service (Service) staff have been instrumental in promoting and supporting the development of this document: Benjamin N. Tuggle, Regional Director, Region 2; Wendy Brown, Region 2 Recovery Coordinator; John Morgart, former Mexican Wolf Recovery Coordinator; Steve Chambers, Region 2 Senior Scientist; and John Slown, Biologist. Maggie Dwire, Assistant Mexican Wolf Recovery Coordinator, and John Oakleaf, Mexican Wolf Field Projects Coordinator, contributed tremendous time, information, and institutional knowledge of the program without which this document would not have been possible. Service employees Julie McIntyre, Brady McGee, John Slown, and Sarah Rinkevich assisted with literature compilation; Melanie Ikenson provided litigation summaries. The Mexican Wolf Adaptive Management Oversight Committee (AMOC) members also contributed profoundly to the development of the document with their insights and critique. In particular, AMOC members Terry Johnson – Arizona Game and Fish Department (AGFD), Matt Wunder and former AMOC member Chuck Hayes – New Mexico Department of Game and Fish (NMDGF), Dave Bergman - U.S. Department of Agriculture – Wildlife Services (USDA-WS), and Cathy Taylor – U.S. Forest Service (USFS) provided substantive feedback.

Most importantly, the Southwest Distinct Population Segment (emphasis on Mexican gray wolf, *Canis lupus baileyi*) (SWDPS) Recovery Team, especially the Technical Subgroup, contributed the ideas that form the foundation of this document. The Southwest Region of the Service convened this team in 2003 to revise the 1982 Mexican Wolf Recovery Plan. This document intends to capture the scientific concepts and information that they discussed before the Service put the planning process on hold in 2005 as the agency decided how to respond to several court cases. Their work has not been resumed, although the agency maintains its intent to develop a revised plan.

This document was written under contract to the U.S. Fish and Wildlife Service by Tracy (Scheffler) Melbihess, former Service employee and liaison to the SWDPS Recovery Team.

Literature Citation and Availability

Literature citation should read as follows:

U.S. Fish and Wildlife Service. 2010. Mexican Wolf Conservation Assessment. Region 2, Albuquerque, New Mexico, USA.

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FOREWORD

A conservation assessment, unlike a recovery plan, is not a document required by or defined in the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq*.), or related policies. It has no predetermined format or content mandated by law or policy. Rather, this is a unique document developed in response to the unique needs of the Service at this time. It has been over 25 years since the completion of the 1982 Mexican Wolf Recovery Plan, and an up-to-date description and assessment of the Mexican gray wolf (*Canis lupus baileyi*) (Mexican wolf) recovery effort and relevant technical literature in the Southwest is needed.

The purpose of this conservation assessment is to provide information relevant to the conservation and recovery of the gray wolf in the Southwest. Specifically, the document may provide background information needed for future recovery planning or policy decisions or may highlight issues that warrant attention and resolution. The scope of the document is primarily limited to biological science and related disciplines in order to provide an up-to-date assessment of and scientific basis for gray wolf recovery in the Southwest. The social and economic facets of gray wolf recovery are recognized as equally important, and at times inextricably linked to the biological aspects, but are beyond the realm of information this document strives to provide.

The document is organized in three main sections. "Gray Wolf Recovery in the Southwest: The Past to the Present" briefly reviews the decline of the gray wolf in the Southwest and the inception of Mexican wolf recovery efforts pursuant to the ESA, focusing on the development of a binational Mexican wolf captive breeding program and reintroduction of the Mexican wolf in Arizona and New Mexico. The current status of the Mexican wolf in the wild is then provided. "Gray Wolf Biology and Ecology" provides an overview of basic gray wolf biology and ecology, with descriptive information on the Mexican wolf where available and informative. Synthesized data from the 5-Year Review of the reintroduction project is provided throughout this section, in some cases updated with annual data from the years following the review (2004-2008). In "Conservation Assessment", a five-factor analysis is conducted to ascertain the security of the wild Mexican wolf population, followed by the identification of a set of three conservation principles (*resiliency*, *redundancy*, and *representation*) that are used to structure discussion of the current recovery effort in the Southwest. "Summary statements" throughout the document serve as focal points of the assessment. These statements are not recommendations, nor do they have any regulatory standing. Rather, they are provided as a communication tool.

The terms used to identify the wolf that is the subject of this conservation assessment are subtle but distinct. The gray wolf, *Canis lupus*, is the entity listed on the List of Endangered and Threatened Wildlife (50 CFR 17.11(h)) and protected by the ESA; therefore, it is appropriate from a policy, and at times biological, standpoint to use the term "gray wolf." Due to the Service's regional division of gray wolf recovery efforts, it is also useful at times to refer to the gray wolf in specific regions of the country. Thus, when the term "gray wolf" is used in reference to the Service's gray wolf recovery programs in the Mountain-Prairie and Pacific regions or the Great Lakes, Big Rivers Region, it describes the gray wolves located there. In the Southwest, the situation becomes more complex. Here, the gray wolf recovery focus has been on the Mexican wolf, a subspecies of gray wolf that historically inhabited the southwestern region of the United States and Mexico. Since this recovery program, from a policy standpoint, is conducted under the umbrella of the Service's gray wolf recovery efforts, it is at times referred to in the assessment as "gray wolf recovery" or "gray wolf recovery in the Southwest." However, given the Southwest Region's heretofore subspecific focus on the Mexican wolf and the formal title of its recovery program - Mexican Wolf Recovery Program - the assessment uses the term "Mexican wolf" when providing biological information specific to the subspecies, as well as in the context of the agency's commitment to conserve the subspecies, the ongoing Mexican wolf reintroduction, the captive breeding program, and the subspecific focus of the 1982 Mexican Wolf Recovery Plan.

Further, in keeping with the current management structure of the Mexican wolf recovery effort, the conservation assessment distinguishes between the Service's Mexican Wolf Recovery Program and the interagency Mexican Wolf Blue Range Reintroduction Project by the use of the terms "program" and "project", respectively.   The project is one component of the recovery program, which encompasses reintroduction, captive breeding, and all related conservation activities for the Mexican wolf. The conservation assessment also uses two similar but importantly different terms when discussing Mexican wolves that have been reintroduced to the wild. The term "Blue Range Wolf Recovery Area", or BRWRA, refers to an exact geographic location and its accompanying regulations as defined by Federal regulation (50 CFR 17.84(k)). The term "Blue Range population" is used to refer to wolves within the BRWRA as well as wolves that have traveled onto nearby tribal or private land, as all of these wolves are functioning biologically as a single population. Thus, BRWRA is a formal geographical designation, whereas "Blue Range population" is an informal term for the reintroduced population.

The Southwest Region (or, Region 2) of the Service includes the states of Arizona, New Mexico, Oklahoma, and Texas. Mexican wolf recovery and reintroduction efforts to date have taken place in Arizona and New Mexico. However, southern portions of Colorado and Utah have been included in recent Service policy decisions related to the Southwest that were overturned by court decisions (see "Status and Implications of Gray Wolf Recovery in the Northern Rockies and Great Lakes for the Southwest"). Thus, the assessment does not attempt to define "Southwest" or "southwestern" in recognition that such definitions are context dependent, but instead uses these terms broadly as a general reference to this region of the country. When precise locations are required for accuracy, they are provided.

While these various terms are used for clarity, adherence to policy, and consistency with current terminology used in the Southwest Region, they may unfortunately cause confusion. However, the assessment does not change the listed status of, commitment to, focus of, or any other aspect of the Service's existing wolf program in the Southwest Region or any other region.

EXECUTIVE SUMMARY

GRAY WOLF RECOVERY IN THE SOUTHWEST: THE PAST TO THE PRESENT

The Mexican wolf was listed as an endangered subspecies in 1976 due to near extinction resulting from predator extermination programs in the late 1800s and early to mid-1900s. This subspecies of gray wolf historically inhabited the southwestern United States and Mexico. In 1978, the Service subsumed this and several other gray wolf subspecies listings into a species-level listing for the gray wolf in order to protect the species throughout its range in the coterminous United States and Mexico. The Service initiated recovery programs for the gray wolf in three broad geographical regions of the country; the Northern Rockies, the Great Lakes, and the Southwest. In the Southwest, a recovery plan was developed for the Mexican wolf, solidifying the regional gray wolf recovery focus on the conservation of this subspecies. The 1982 Mexican Wolf Recovery Plan recommended a two-pronged approach to recovery that included establishment of a captive breeding program and reintroduction of wolves to the wild. The plan, however, did not establish recovery criteria for the Mexican wolf, as did the 1992 Recovery Plan for the Eastern Timber Wolf and the 1987 Northern Rocky Mountain Wolf Recovery Plan for their respective regions of the country. The Service has never developed a range-wide recovery plan for the gray wolf in the coterminous United States.

Captive breeding of Mexican wolves began in 1981, expanding into a binational effort between the United States and Mexico to produce wolves for reintroduction. In the United States, Mexican wolves were reintroduced to the wild in 1998 in Arizona and New Mexico as a nonessential experimental population pursuant to section 10(j) of the ESA. Today, an interagency partnership of Federal, State, County, and Tribal entities manages the reintroduction. As of the December 31, 2009, annual minimum population count, the reintroduced Mexican wolf population numbers approximately 42 wolves, less than half the of the reintroduction's objective to establish a single population of at least 100 wolves. Projections had estimated that the population objective would be met in 2006. The biological progress of the reintroduction has been evaluated in two analyses at three and five years after the inception of the reintroduction effort. Both analyses identified regulatory mechanisms that were slowing the progress of the population, including the internal and external boundaries (and associated regulations limiting release of captive-raised wolves to a small subset of the recovery area and requiring capture of wolves that establish territories outside of the recovery area) of the Blue Range Wolf Recovery Area (BRWRA), and provided a number of recommendations to improve the progress of the reintroduction.

Although substantial progress in implementing the 1982 Mexican Wolf Recovery Plan has been achieved, a revised recovery plan has never been developed to establish recovery criteria specific to the Mexican wolf subspecies or the gray wolf in the Southwest Region. Thus, other than the population objective for the reintroduced Mexican wolf population in Arizona and New Mexico, the gray wolf recovery effort in the Southwest operates without any guidance in terms of the number and distribution of wolves considered adequate for recovery and delisting. A recovery team was convened by the Southwest Region in 2003 to revise the 1982 plan, but the Service put the effort on hold in 2005 as it determined how to respond to several court cases related to gray wolf reclassification and delisting. Although the Service has resolved these issues and moved forward with delisting gray wolves in the Northern Rockies and Great Lakes, the recovery team has not been reconvened.

GRAY WOLF BIOLOGY AND ECOLOGY

The gray wolf, *Canis lupus*, is a member of the dog family (*Canidae: Order Carnivora*). To date, five subspecies of gray wolf are recognized in North America, including the Mexican wolf.

Gray wolves are typically a mottled gray, but pelt color can range from white, cream, brown and red, to dark gray and black. Mexican wolves tend to be patchy black, brown to cinnamon, and cream in color. Gray wolves typically weigh between 36-45 kilograms (kg) (80-120 pounds (lbs)), are 1.5-2 meters (m) (5-6.5 feet (ft)) long from tip of nose to tip of tail, and 0.6-0.8 m (2-2.5 ft) high at the shoulder. The Mexican wolf is somewhat smaller; adults weigh 23-41 kg (50-90 lbs), with a length of 1.5-1.8 m (5-6 ft) and height at shoulder 0.6-0.8 m (2-2.5 ft).

Gray wolves typically live four to five years in the wild, reaching sexual maturity at two years of age. Female wolves may produce a litter of several pups each spring. Litter sizes of Mexican wolves in the Blue Range population documented during opportunistic pup counts are smaller than other gray wolf populations or captive Mexican wolves. Recent research suggests that inbreeding depression may be partially responsible for small litter size; several ecological hypotheses have also been suggested, but data has not been collected to support or refute them. Early pup mortality and low pup recruitment into the population may also explain the small number of pups observed. Offspring remain with their family until they disperse to establish a new territory. These hierarchical family units are referred to as packs.

Documented causes of death in North American gray wolves include starvation, disease, human-caused mortality, and interactions with other wolves or predators. In the Blue Range population, causes of mortality have been largely human-related (primarily illegal shooting and secondarily vehicular collision).

Wolves are top predators that have flexibility in using different prey and habitats. Historically, wolves occupied every habitat in the northern hemisphere that supported populations of large hoofed mammals (ungulates). Wolf packs establish territories in which they hunt for prey, primarily pursuing medium to large hoofed mammals. Historically, Mexican wolves were associated with montane woodlands characterized by sparsely- to densely-forested mountainous terrain and adjacent grasslands in habitats found at elevations of 4000-5000 ft where ungulate prey were numerous. Today, elk (*Cervus elaphus*) are the preferred prey of Mexican wolves in the BRWRA. Other sources of prey include deer (*Odocoileus virginianus* and *Odocoilus hemionus*), small mammals, and occasionally birds. Livestock are another source of prey for the Mexican wolf; between 1998 and 2008, 123 confirmed cattle depredations occurred.

Wolves may interact with many other predators, including coyotes (*C. latrans*), mountain lions (*Puma concolor*), and black bears (*Ursus americanus*). Wolves may also interact with humans, although wild wolves are generally not considered a threat to humans. Humans can be a significant source of mortality for wolves.

CONSERVATION ASSESSMENT

Threats to the Gray Wolf in the Southwest

Species, subspecies, and distinct populations are listed as threatened or endangered if it is determined that one or more of the following five factors in section 4(a) (1) of the ESA are responsible for their condition. These five factors are reassessed periodically while the species is listed to evaluate its status and ensure that conservation actions are appropriately tailored to address current threats to the species.

(A) the present or threatened destruction, modification, or curtailment of its habitat or range;
The three fundamental ecological conditions necessary for wolf habitat include large area size, adequate prey, and security from human-caused mortality. Threats related to the destruction, modification, or curtailment of habitat do not likely threaten the Mexican wolf at the current time: the Blue Range population has remained constant in size since reintroductions began in 1998; additional tribal lands are now available to support reintroduction efforts; and there is no indication that wolves are food-limited. Although vehicle-related deaths to wolves do occur each year, the incidence of mortality from vehicles can be accommodated by the wolf population without a significant impact. Future habitat suitability for wolves in the Southwest and Mexico may decrease over time due to human population growth and resultant development on public and private lands.

(B) overutilization for commercial, recreational, scientific, or educational purposes;
Overutilization for commercial, recreational, scientific, or educational purposes is not considered a threat to the Mexican wolf because the Service does not authorize legal killing or removal of wolves from the wild for commercial, recreational (i.e., hunting), scientific, or educational purposes. Illegal killing or trafficking for pelts is not known to occur. Non-lethal techniques are used during Mexican wolf research in the reintroduced and captive populations.

(C) disease or predation;
A number of viral, fungal, and bacterial diseases and endo- and ectoparasites have been documented in gray wolf populations, but there is little research specific to disease or contaminant issues in Mexican wolves. Only one wolf death due to disease (distemper) has been documented in the wild population, as well as four disease-related deaths of wild wolves brought into captivity (therefore classified as captive deaths), including two deaths from canine distemper and two from parvovirus. A rabies outbreak is currently occurring among other species of wildlife in the recovery area, but has not yet been documented in Mexican wolves. Mexican wolves are routinely vaccinated for rabies, distemper, parvovirus, and corona virus before release to the wild from captive facilities, and opportunistically when

handled in the wild. Disease is not currently considered a threat to the Mexican wolf based on known occurrences in the reintroduced population and the active vaccination program. The potential remains for disease to threaten the population in the future.

Predation is not considered a threat to the Mexican wolf because no wild predator regularly preys on wolves and only a small number of predator-related wolf mortalities have been documented in the reintroduced population. "Human predation" of wolves is addressed under factor (E).

(D) the inadequacy of existing regulatory mechanisms;
A number of concerns have been raised regarding the adequacy or appropriate implementation of regulatory and management mechanisms being applied to the Mexican wolf reintroduction project, including: 1) the internal and external boundaries of the Blue Range Wolf Recovery Area (BRWRA), including the configuration of the Primary and Secondary Recovery Zones and the regulations governing removal of wolves due to boundary violations; 2) regulations or management procedures for livestock management (e.g., carcass removal and other husbandry practices); 3) management procedures related to livestock depredation (i.e., Standard Operating Procedure 13 (SOP 13)); 4) implementation of conservation actions by Federal agencies pursuant to section 7(a)(1) of the ESA; 5) the alleged transfer of management authority of the reintroduction project from the Service to the AMOC; and, 6) failure to complete a revision of the 1982 Mexican Wolf Recovery Plan with objective and measurable delisting criteria, as required by the ESA.

Based on data analyses in the 3-Year Review, 5-Year Review, and subsequent IFT annual reports, several of these mechanisms appear to be hindering the growth of the population toward the objective to establish a population of at least 100 wild wolves – the internal and external boundaries of the BRWRA and SOP 13. Further, failure to develop an up-to-date recovery plan results in inadequate guidance for the reintroduction and recovery effort. The Service has not adjusted its regulatory mechanisms, and only recently made adjustments to its management mechanisms. In May 2009, a Clarification Memo to SOP 13 to better support the biological progress of the population was approved. In December of 2009, the United States District Court of Arizona approved a settlement agreement between the Service and several environmental NGO plaintiffs that had challenged the MOU and SOP 13 (Defenders, et al. v. U.S. Fish and Wildlife Service et al., 08-cv-280 (D. Ariz.)). The settlement agreement read, in part, "The Service shall make no further decisions that relate to the Mexican Wolf Recovery Program pursuant to SOP 13 as issued on April 30, 2005, or as altered by the Clarification Memo on May 28, 2009." A new management framework has yet to be established, however, the Service and its partners remain committed to managing wolves to support the biological processes of the population, while minimizing potential economic impact of wolves to livestock and other interests.

(E) other natural or manmade factors affecting its continued existence.
Recent (Research and Polling, Inc. 2008) public polling in Arizona and New Mexico shows that the majority of respondents has positive feelings about wolves and supports the reintroduction of the Mexican wolf to public land. Therefore, general public opinion is not considered a threat to the Blue Range population.

In the Southwest, illegal shooting of wolves is the single greatest source of wolf mortality in the reintroduced population. Between 1998 and June 1, 2009, 31 of 68 deaths were due to illegal shooting of wild wolves. In several years, illegal shooting resulted in Blue Range population declines of close to or exceeding 10 percent.

In the Blue Range population, two hybridization events between Mexican wolves and dogs have been documented over the span of the reintroduction. Offspring from these events were humanely euthanized. No hybridization events between Mexican wolves and coyotes have been documented. Based on the number of occurrences, hybridization is not considered a threat to the Blue Range population.

The Mexican wolf captive and reintroduced populations are based on seven founders from three lineages (McBride, Aragon, and Ghost Ranch). The McBride lineage represents the original founders of the captive population; the other two lineages were added more recently and are thus less well-represented. Recent research on the effects of inbreeding on the probability of producing live pups, litter size, and pup survival has documented inbreeding depression in the captive and reintroduced Mexican wolf populations. Crosses between F1 wolves (the offspring of crosses between wolves of different lineages) produced 3.2 times more pups on average than contemporary crosses between the original McBride lineage wolves. In the Blue Range population, research documented that inbreeding depression has resulted in smaller litter sizes in packs producing pure McBride pups compared to those producing cross-lineage pups, demonstrating restored fitness in wolves with mixed ancestry (Fredrickson et al. 2007). Inbreeding is not considered a current threat to the captive population due to active management that minimizes the risk of inbreeding depression to the captive population, but has the potential to decrease the fitness, growth rate, and genetic variation of the Blue Range population unless the representation of Ghost Ranch and Aragon ancestry is increased.

The assessment has not identified any individual threats that are so severe as to put the population at immediate risk of extinction, although management and regulatory mechanisms, illegal shooting, and inbreeding are identified as threats that are hindering the growth and fitness of the Blue Range population. However, the population does not experience a single threat in absence of the others, but rather all threats simultaneously or at least within spatial or temporal proximity to one another. As a rule of thumb, an overall mortality rate of 0.34 (34 percent) has been estimated as the inflection point for wolf populations, with populations increasing naturally when mortality rates are below this average and decreasing when mortality rates are above it. Combined sources of mortality and removal are consistently resulting in failure rates at levels too high for unassisted population growth. The Mexican wolf is more susceptible to population decline at a given mortality rate than other gray wolf populations because of lower reproductive rates, smaller litter sizes, less genetic diversity, lack of immigration from other populations, and potential low pup recruitment. Thus the cumulative impact of identified threats to the Blue Range population, coupled with its biological attributes, is putting the population at risk of failure.

<u>The Conservation Principles of Resiliency, Redundancy, and Representation</u>

The principles of *resiliency*, *redundancy*, and *representation* are a recently popularized conceptualization of key elements of biological diversity conservation. They provide a useful framework for discussing scientific concepts relevant to gray wolf conservation and recovery in the Southwest, including demography, environmental variability, and genetics. The Service has invoked these principles to describe recovery efforts for the gray wolf in the Northern Rockies and Great Lakes, and for consistency, the conservation assessment uses these principles in similar fashion.

Resiliency
The principle of *resiliency* suggests that species that are more numerous and widespread are more likely to persist than those that are not. That is, a species represented by a small population faces a higher risk of extinction than a species that is widely and abundantly distributed due to the sensitivity of small populations to stochastic (that is, uncertain) demographic events. In small populations, including those with a positive growth rate, it is more likely that a wide negative deviation from average birth or survival rates could result in a decline toward extinction from which the population would not be able to recover. Thus, as a population grows larger and individual events tend to average out, the population becomes less susceptible to demographic stochasticity. There is not a single population size that will ensure persistence. Rather, populations of various sizes, vital rates, and biological and ecological characteristics will simply have different risks of extinction. At its current size, the Blue Range population is highly susceptible to stochastic demographic events.

A variety of methods are available for estimating a species' likelihood of persistence or extinction risk, ranging from complex theoretical or simulation models to simple observation of existing populations or best professional judgment. Viable wolf populations have been estimated in the scientific literature and previous gray wolf recovery plans as those that number in the hundreds to the thousands, depending on a number of factors. A current, complete, peer-reviewed viability analysis of the objective to establish a population of at least 100 wolves in the Southwest has not been conducted to determine the extinction risk faced by this population. No other population objective (i.e., recovery criteria) has been determined for the Southwest Region upon which to evaluate the degree to which the current reintroduced population establishes or contributes to regional *resiliency*.

Redundancy
Redundancy refers to the existence of redundant, or multiple, populations spread throughout a species' range. It advances the notion that a species' likelihood of persistence generally increases with an increase in the number of sites it inhabits because it allows for populations to exist under different abiotic and biotic conditions, thereby providing a margin of safety that random perturbation (or, variation) affects only one, or a few, but not all, populations.

Random variations in the environment that in turn affect the demography of a population are referred to as environmental stochasticity. Environmental stochasticity may take the form of variation in available resources (e.g., prey base), or in direct mortality (e.g., a disease epidemic). Extreme environmental events, referred to as catastrophic, including events such as wildfire, drought, or a disease epidemic, may result in drastic, rapid population declines.

The scientific literature does not recommend a specific number or range of populations appropriate for conservation efforts, although rule of thumb guidelines for the reintroduction of a species from captivity recommends that at least two populations be established that are demographically and environmentally independent.

When a species is distributed in redundant populations, there are two possible relationships between the populations: they can be completely isolated from each other, or they can be connected with one another through the dispersal of individual animals. If connectivity between populations is desired, conservation efforts must ensure that the distance between populations is compatible with wolf dispersal abilities and that the habitat through which individuals will be dispersing is of sufficient quality and quantity to support immigration. Alternatively, artificial immigration between populations must be accomplished through the translocation of wolves by management. For a species that has been extirpated from so much of its historic range, explicit effort must be made to recreate redundancy.

Numerous habitat assessments have been conducted to identify possible areas for reestablishment of the gray wolf in Arizona, New Mexico, Utah, Colorado, and Mexico. However, the number of redundant populations and related connectivity appropriate for recovery in the Southwest has not been specified. The establishment of a single population provides the least amount of redundancy, and therefore the least possible security against extinction risk from environmental variation.

Representation

Representation refers to the genetic variation represented by members of a population or species, specifying that higher levels of variation better support ecological and evolutionary processes than low levels. *Representation* also suggests that a species should be conserved in a variety of habitats in order to conserve ecosystem structure and function.

Attention to genetic structure and diversity may be a critical component of conservation efforts for small populations due to the likelihood for genetic drift to occur. It can influence the persistence of a population through several outcomes, including loss of phenotypic variation, loss of adaptive potential, and the buildup of harmful mutations, including mitochondrial mutations. Small populations are also at greater risk of inbreeding depression (a reduction of fitness due to inbreeding) due to the smaller pool of unrelated potential mates available as compared to a larger population. Intensive management of genetic diversity has been an integral component of the Mexican wolf captive breeding program and reintroduction project due to the small number of founders upon which the captive breeding program was established. Management of the captive population has focused on ensuring the representation of genes from each of the three founding lineages and on the continued maximization of overall gene diversity retention. Management of the reintroduced population has also focused on achieving representation from each of the three lineages, but maximization of gene diversity in the wild population is not achieved due to regulatory mechanisms and management protocols that address other biological, social, and economic concerns. Inbreeding depression has been observed in captive and reintroduced Mexican gray wolves.

Effective population size, rather than the census population size, provides a measuring stick for determining a population's risk of genetic drift and inbreeding. Several general (non-species specific) rules of thumb have been presented in the scientific literature to inform efforts for conservation of a species' or populations' genetic diversity. These range from effective population sizes of several dozens of animals to avoid immediate fitness-related issues, to effective population sizes of hundreds to thousands of animals to preserve long-term adaptive potential. For the gray wolf, social (mating) structure greatly affects estimation of effective population size. The effective population size of a census population of 100 Mexican wolves has been estimated at approximately 28 wolves. Determination of an effective population size for regional gray wolf recovery in the Southwest has not been made, and thus the degree to which the reintroduced population contributes to *representation* cannot be evaluated.

Consideration of ecosystem *representation* specifies that a species should be conserved in the variety of habitats in which it occurs in order to maintain the structure and function of ecosystems. Recent scientific exploration of the emerging concept of "ecologically effective densities" supports the recovery of strongly interacting species such as wolves to densities at which they provide ecosystem-level effects. Gray wolves used to inhabit much of the Southwest, from its southern-most extent (and down into Mexico), through the Southern Rockies, an area that included a variety of habitat types ranging from semi-desert grasslands to coniferous forests. The Mexican wolf currently inhabits only the BRWRA and the adjacent Fort Apache Indian Reservation (FAIR), and therefore is not conserved in a variety of habitats. Although the ESA does not mandate that a species be reestablished throughout its historic range or in all of the habitat types in which it historically occurred in order to achieve recovery, it does promote the conservation of ecosystems that support listed species.

CONCLUSION

The gray wolf recovery effort in the Southwest Region consists of a Mexican wolf captive breeding program and a reintroduction project to reestablish a population of at least 100 wolves in the wild. As envisioned by the 1982 Mexican Wolf Recovery Plan, these efforts have ensured the survival of the Mexican wolf. The Blue Range population, although successfully established since 1998, is not thriving. Threats hindering the biological progress of the population and the recovery program include regulations associated with the internal and external boundaries of the BRWRA, management regulations associated with SOP 13 (no longer in effect as of December 2009); lack of an up-to-date recovery plan; illegal shooting; and inbreeding. Although no single threat is responsible for the delayed progress of the reintroduction or the recent decline in population size and number of breeding pairs, the cumulative effect of these threats results in a consistently high level of mortality, removal, and reduced fitness that, when combined with several biological parameters, threatens the population with failure.

Consideration of the principles of *resiliency, redundancy,* and *representation* suggests that the Blue Range population is susceptible to stochastic demographic events at its current size, and has an unknown extinction risk at the population target of 100; multiple populations enhance the likelihood of Mexican wolf persistence more than a single population; and short-term fitness and long-term adaptive potential of populations is best supported by establishing larger, rather than smaller, effective population sizes. Although a quantitative determination of the degree to which the reintroduced population contributes to *resiliency*, *redundancy*, and *representation* is precluded by a lack of recovery criteria against which the population objective to establish a single population of at least 100 wolves can be evaluated, it is clear that the establishment of this population does not achieve *resiliency*, *redundancy*, or *representation*.

ABBREVIATIONS AND ACRONYMS

3-Year Review	Mexican Wolf Recovery: Three Year Program Review and Assessment
5-Year Review	Mexican Wolf Blue Range Reintroduction Project 5-Year Review
AGFD	Arizona Game and Fish Department
AMOC	Adaptive Management Oversight Committee
AMOC and IFT	Adaptive Management Oversight Committee and Interagency Field Team, commonly used as a literature citation referencing these committees as authors of sections of the 5-Year Review, including the Technical Component (TC), Administrative Component (AC), or AMOC Recommendations Component (ARC)
AMWG	Adaptive Management Working Group
APA	Administrative Procedures Act of 1946
AZA	Association of Zoos and Aquariums
Blue Range population	Wolves in the BRWRA, FAIR, and surrounding areas
BRWRA	Blue Range Wolf Recovery Area, as designated by the Final Rule (50 CFR 17.84(k))
DPS	Distinct Population Segment
EIS	Environmental Impact Statement
ESA	Endangered Species Act of 1973, as amended
FAIR	Fort Apache Indian Reservation of the White Mountain Apache Tribe
FEIS	Final Environmental Impact Statement of 1996 (for proposed reintroduction of Mexican wolves)
Final Rule	Final "nonessential experimental population" or "10(j)" rule of 1998 for Mexican wolf reintroduction in Arizona and New Mexico, 50 CFR 17.84(k)
Great Lakes	USFWS gray wolf recovery program administered out of the Great Lakes, Big Rivers Region (Region 3)
IFT	Interagency Field Team (for the Reintroduction Project, see below)
MVP	Minimum Viable Population
MWEPA	Mexican Wolf Experimental Population Area
NEPA	National Environmental Policy Act of 1969
NMDGF	New Mexico Department of Game and Fish
Northern Rockies	USFWS gray wolf recovery program administered out of the Mountain-Prairie Region (Region 6) and Pacific Region (Region 1)
PVA	Population Viability Analysis
SOP	Standard Operating Procedure for the Reintroduction Project
SSP	Species Survival Program
SWDPS	Southwestern Gray Wolf Distinct Population Segment

SWDPS Recovery Team	Southwestern Gray Wolf Distinct Population Segment (with emphasis on the Mexican gray wolf, *Canis lupus baileyi*) Recovery Team
USDA-WS	US Department of Agriculture-Animal Plant Health Inspection Service, Wildlife Services
USFWS or Service	US Fish and Wildlife Service
USFS	USDA Forest Service
WMAT	White Mountain Apache Tribe

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GRAY WOLF RECOVERY IN THE SOUTHWEST: THE PAST TO THE PRESENT

Decline of the Gray Wolf in the Southwestern United States and Mexico

Gray wolves were once abundant and widespread in North America; pre-European settlement, the gray wolf ranged from the Canadian high arctic through the United States to central Mexico (Mech 1970, Wayne and Vilá 2003). Prior to the late 1800s, gray wolves ranged across the landscape of the southwestern United States in montane forests and woodlands (Young and Goldman 1944). In southern Arizona, Mexican wolves inhabited the Santa Rita, Tumacacori, Atascosa-Pajarito, Patagonia, Chiricahua, Huachuca, Pinaleno, and Catalina mountains, west to the Baboquivaris and east into New Mexico (Brown 1983). In central and northern Arizona, Mexican wolves and several formerly recognized subspecies of gray wolf were interspersed (Brown 1983). Mexican wolves and up to four formerly recognized subspecies were present throughout New Mexico, with the exception of low desert areas, and were documented as numerous or persisting in areas including the Mogollon, Elk, Tularosa, Diablo and Pinos Altos mountains, the Black Range, Datil, Gallinas, San Mateo, Mount Taylor, Animas, and Sacramento mountains (Brown 1983). Mexican wolves frequented the borderlands between Mexico and the US, and were abundant in the Sierra Madre and the altiplano (high plains) of Mexico (Brown 1983). Gray wolves ranged eastward into the Trans-Pecos region of Texas, Oklahoma, and northward up the Rocky Mountains (Young and Goldman 1944). In Colorado, gray wolves inhabited both sides of the Continental Divide, including the eastern plains (Young and Goldman 1944). In Utah, gray wolves were restricted to the southern and eastern portions of the state.

Population estimates of gray wolves, and specifically Mexican wolves, prior to control actions in the late 1800s and early to mid 1900s are not available for the Southwest or Mexico. This is due primarily to a lack of available data on wolf abundance, but also to difficulty in interpreting anecdotal accounts of wolf abundance in light of evolving gray wolf taxonomy (see “Taxonomy and Range”). Anecdotal pre-colonization estimates for New Mexico suggested a state-wide population of about 1500 gray wolves (Bednarz 1988). It has been hypothesized that close to 400,000 gray wolves likely inhabited the western United States (Leonard et al. 2005).

In the Southwest, conflict between wolves and humans began to escalate in the 1800s as human settlement intensified in the region and wolf depredation of livestock increased. Individual wolves gained infamy for purported levels of depredation, although the validity of some of these accounts is questionable (Gipson et al. 1998, Gipson and Ballard 1998). Federal control programs and extermination campaigns, coupled with habitat alteration resulting from the intensification of agriculture and livestock operations, led to the near extinction of the gray wolf in the Southwest by the early 1900s (Brown 1983). By 1925, poisoning, hunting, and trapping efforts had drastically reduced wolf populations in all but a few remote areas of the southwestern United States, and control efforts shifted to wolves in the borderlands between the United States and Mexico (Brown 1983). Bednarz (1988) estimated that breeding populations of Mexican wolves were extirpated from the United States by 1942. The use of increasingly effective poisons and trapping techniques during the 1950s and 1960s eliminated remaining wolves north of the border. Occasional reports of wolves crossing into the United States from Mexico persisted to the 1960s, and small pockets of wolves likely persisted in Mexico until the 1980s. McBride (1980) estimated that fewer than fifty breeding pairs of Mexican wolves inhabited Mexico by 1978.

The passage of the ESA in 1973 marked the beginning of Federal efforts to prevent the extinction of the Mexican wolf. The Service originally added several subspecies of gray wolf, including the Mexican wolf, from different regions of the United States to the list of threatened and endangered species (for the Mexican wolf, 41 FR 17736-17740, April 28, 1976). Within a few years, however, the agency determined that the gray wolf warranted broad geographic protection, and subsumed the subspecies listings into a species-level listing to protect the species throughout its range in the coterminous United States and Mexico (43 FR 9607-9615, March 9, 1978). This reclassification provided a commitment that the Service would maintain a conservation focus on recognized gray wolf subspecies although it simultaneously recognized that some of the gray wolf taxonomy used in previous subspecies listings was out of date.

The Service did not establish a coordinated, national gray wolf recovery program to address its range-wide listing of the gray wolf. Instead, the agency initiated independent regional recovery efforts in three core geographic areas: Minnesota, Michigan, and Wisconsin ("Great Lakes", administered by the Service's Great Lakes, Big Rivers Region); Idaho, Montana, and Wyoming ("Northern Rockies", administered by the Service's Mountain-Prairie Region and Pacific Region); and Arizona, New Mexico, and Texas, in coordination with Mexico (administered by the Service's Southwest Region). Recovery plans were developed in each of these three areas to organize and prioritize recovery actions appropriate to the unique local circumstances of the gray wolf. The Mexican Wolf Recovery Plan was finalized in 1982, solidifying the focus of gray wolf recovery efforts in the southwestern United States on the Mexican wolf subspecies (USFWS 1982). The recovery plan was binational, signed by the Service in the United States and the Dirección General de la Fauna Silvestre in Mexico.

Summary statement: The Mexican wolf was on the brink of extinction by the time it was protected by the ESA in 1976, with no known wolves regularly inhabiting the United States and fewer than 50 breeding pairs inhabiting Mexico and the borderlands between the two countries.

Summary statement: The Mexican wolf subspecies has been the focus of the Service's gray wolf conservation and recovery efforts in the Southwest since 1976. The Southwest Region finalized a recovery plan for the Mexican wolf in 1982.

<u>The Establishment of the Mexican Wolf Recovery Program</u>

The 1982 Mexican Wolf Recovery Plan laid out a "prime objective" to

> conserve and ensure and survival of *Canis lupus baileyi* by maintaining a captive breeding program and re-establishing a viable, self-sustaining population of at least 100 Mexican wolves in the middle to high elevations of a 5,000-square-mile area within the Mexican wolf's historic range (USFWS 1982:23).

This prime objective established a two-pronged approach to recovery (i.e., captive breeding and reintroduction of wolves to the wild) that has guided the Service's Mexican Wolf Recovery Program ever since. The prime objective was not, however, considered an objective and measurable recovery criterion for delisting as required by section 4(f) (1) of the ESA. Instead it was a recommendation to ensure the immediate survival of the Mexican wolf. In 1982 the recovery team stopped short of providing recovery criteria because they could not foresee full recovery and eventual delisting of the Mexican wolf due to its dire status in the wild and the increasing encroachment of humans into wolf habitat (USFWS 1982: 23).

The recovery effort's first Mexican wolf pups were conceived and born in captivity in the United States in 1981 (Parsons 1996, Hedrick et al. 1997, Lindsey and Siminski 2007). These pups were the result of a breeding program founded by three of the last six Mexican wolves removed from the wild. Mexico joined the captive breeding effort in 1987 (SEMARNAP 2000), and by 1994, the binational breeding program had produced a captive population of 92 wolves. These founding wolves and their offspring were initially referred to as the Certified lineage, later renamed the McBride lineage. As the program continued, concern began to surface over the limited genetic diversity of the captive population and the potential for inbreeding depression to hinder its success (Parsons 1996, Hedrick et al. 1997). Thus, in 1995, after definitive genetic testing methods became available and were applied, two additional lineages of pure Mexican wolves, the Ghost Ranch lineage, founded by two wolves, and the Aragon lineage, founded by two wolves, were integrated into the captive breeding program to increase the genetic diversity of the founder population. This raised the founding base of the captive population from three to seven pure Mexican wolves (Hedrick et al. 1997). The Association of Zoos and Aquariums developed a Species Survival Plan for the captive population (AZA Mexican Wolf SSP) to establish breeding protocols and genetic goals to guide wolf pairings. The ultimate objective of the AZA Mexican Wolf SSP is providing healthy offspring for release to the wild, while conserving the Mexican gray wolf subspecies genome (Parsons 1996, Lindsey and Siminski 2007).

In the Southwest, plans for the reintroduction of the Mexican wolf to the wild began to develop in the early-1990s, stimulated in part by a suit filed against the Service by seven environmental organizations for failure to implement provisions of the ESA (Wolf Action Group, et al. vs. United States, Civil Action CIV-90-0390-HB, U.S. District Court, New Mexico). During this time, the Service formed a new recovery team to revise the 1982 Mexican Wolf Recovery Plan with updated scientific information and recovery criteria. The draft recovery plan developed by the new recovery team was not finalized. The prime objective of the 1982 recovery plan to establish a population of at least 100 wolves in the wild was maintained as a guiding recommendation for the upcoming reintroduction. Several analyses were conducted to assess locations for the reintroduction (Johnson et al. 1992, USFWS 1993), culminating with the Final Environmental Impact Statement, "Reintroduction of the Mexican Wolf within its Historic Range in the Southwestern United States," (FEIS) (USFWS 1996).

By 1998, the plans for the reintroduction were solidified in the final rule, "Establishment of a Nonessential Experimental Population of the Mexican Gray Wolf in Arizona and New Mexico" (Final Rule) (63 FR 1752-1772, January 12, 1998), and in March of that year, 11

Mexican wolves from the captive breeding program were released to the wild. The strategy for the reintroduction was to release 14 family groups of wolves over a period of 5 years in order to establish the population (63 FR 1752-1772, January 12, 1998). The FEIS projected that the population target of at least 100 wild wolves and 18 breeding pairs would be reached in 9 years, in 2006 (USFWS 1996). The Final Rule cautioned that failure to reintroduce Mexican wolves to the wild within a reasonable period of time could result in genetic, physical, or behavioral changes from prolonged periods in captivity that could hinder the recovery effort (63 FR 1752-1772, January 12, 1998: 1755). Because a source population of Mexican wolves did not exist in the wild, the reintroduction would be entirely dependent on captive-bred wolves, one of the biggest possible impediments to success (Brown 1983).

The Final Rule established the Mexican Wolf Experimental Population Area (MWEPA) in central Arizona and New Mexico, and designated the reintroduced population as a non-essential experimental population under section 10(j) of the ESA (Figure 1). This designation was justified because wolves released to the wild would represent redundant genetic material produced from the captive breeding program and because it allowed for regulatory flexibility in managing released wolves and their progeny, an important consideration at the time for gaining public support (63 FR 1752-1772, January 12, 1998; Brown and Parsons 2001). Not all of the MWEPA was considered reintroduction and recovery habitat for the Mexican wolf. Much of the MWEPA provided a transition zone between the Blue Range Wolf Recovery Area (BRWRA) designated within the MWEPA and the endangered designation of the surrounding landscape (i.e., wolves outside of the MWEPA have full endangered status under the classification provided by the 1978 gray wolf listing) (63 FR 1752-1772, January 12, 1998). The rule stipulated that the reintroduction of wolves would take place within the BRWRA, a 17,775 km^2 (6,845 mi^2) area that included the Apache National Forest in east-central Arizona and the Gila National Forest in west-central New Mexico. Within the BRWRA, a Primary Recovery Zone in the Apache National Forest was designated for initial release and translocation of Mexican wolves, with a Secondary Recovery Zone in the Gila and Apache National Forests providing dispersal habitat for released wolves (Figure 1). The Final Rule defined the Secondary Recovery Zone as "…an area adjacent to a primary recovery zone in which the Service allows released wolves to disperse, where wolves captured in the wild for authorized management purposes may be translocated and released, and where managers will actively support recovery of the reintroduced population" (63 FR 1752-1772, January 12, 1998). The FEIS, however, made no specific analysis of translocating wolves into the Secondary Recovery Zone (USFWS 1996). The Service prepared an environmental assessment in 2000 to analyze translocation of wolves into the Secondary Recovery Zone, determining that translocation of wolves into the Secondary Recovery Zone of the BRWRA would not create significant new impacts beyond those analyzed in the FEIS (USFWS 2000).

The Service's objective to reintroduce wolves to the wild operated independently of the coordination between the United States and Mexico for the captive breeding program. Mexico developed its own recovery plan, Programa de Recuperación del Lobo Mexicano, in 1999 (SEMARNAP 2000). Mexico's recovery plan supported reintroduction on both sides of the Mexico-United States border, but stated that it would be difficult to find appropriate habitat for reintroduction in Mexico and suggested that the best habitat may exist within the

Sierra Madre Occidental and the Sierra Madre Oriental mountain ranges (SEMARNAP 2000). As of January 2010, Mexican wolves have not been reintroduced to the wild in Mexico.

Summary statement: The Service's Mexican Wolf Recovery Program has pursued a two-pronged strategy consisting of captive breeding and reintroduction to the wild.

Summary statement: The establishment of a binational Mexican wolf captive breeding program between the United States and Mexico prevented impending extinction of the Mexican wolf.

Summary statement: The reintroduction of Mexican wolves to the wild in Arizona and New Mexico began in 1998. The objective of the reintroduction was to establish a single non-essential experimental 10(j) population of at least 100 wolves in the BRWRA, with projections estimating the population target would be met by 2006.

Summary statement: The United States and Mexico operate independently in the planning and implementation of Mexican wolf reintroduction efforts; wolves have not yet been reintroduced to the wild in Mexico.

The Mexican Wolf Blue Range Reintroduction Project

Twelve years after the first Mexican wolves were reintroduced to the wild, the effort to reestablish the Mexican wolf in the Southwest continues. The Mexican wolf is one of only three carnivores [the Mexican wolf, the black-footed ferret (*Mustela nigripes*), and red wolf (*Canis rufus*)] in North America to have been eliminated in the wild, bred in captivity, and reintroduced to the wild (Brown and Parsons 2001). Both Mexican wolf reintroduction in the Southwest and red wolf reintroduction in the eastern United States have relied fully on captive-bred animals. The Service's gray wolf programs in the Northern Rockies and Great Lakes, in contrast, relied on translocation of wild wolves and/or natural recolonization from adjacent source populations.

The Mexican Wolf Blue Range Reintroduction Project (reintroduction project or project) has grown into an interagency effort with State, Tribal, County, and Federal participation. The project has been governed by a Memorandum of Understanding (MOU), signed in 2003, between Arizona Game and Fish Department (AGFD), New Mexico Department of Game and Fish (NMDGF), White Mountain Apache Tribe (WMAT), U.S. Department of Agriculture-Animal and Plant Health Inspection Service Wildlife Services (USDA-WS), U.S. Department of Agriculture Forest Service (USFS), and the Service. These lead agencies have primary regulatory jurisdiction and management authority of the Mexican wolf in Arizona and New Mexico. Graham, Greenlee, and Navajo counties in Arizona, Otero and Sierra Counties in New Mexico, as well as the New Mexico Department of Agriculture, are designated as cooperators to the reintroduction project with an interest in Mexican wolf management. The MOU, which expired in 2008, is currently under revision: in December of 2009, the United States District Court of Arizona approved a settlement agreement between the Service and several environmental NGO plaintiffs that had challenged the MOU and

SOP 13 (Defenders et al. v. U.S. Fish and Wildlife Service et al., 08-cv-280 (D. Ariz.)). The settlement agreement read, in part, "The Service shall make no further decisions that relate to the Mexican Wolf Recovery Program pursuant to the MOU, which has expired and has no legal effect.......The Service recognizes that the AMOC does not oversee the actions of the Service and that the AMOC has no decision-making authority over the Service with regard to the Service's management of the Mexican Wolf Recovery Program or the Mexican Wolf Reintroduction Project." A new collaboration framework has yet to be established, however, the Service remains committed to involving partners in managing Mexican wolves to best support the biological processes of the population, while minimizing potential economic impacts of wolves. The adjoining FAIR tribal lands of the WMAT provide an additional 6,475 km^2 (2,500 mi^2) for potential wolf colonization and releases, pursuant to an agreement signed between the Service and WMAT in 2002.

Turner Endangered Species Fund and Wolf Haven International support the reintroduction project by providing pre-release captive facilities where wolves from the captive breeding program are acclimated prior to release to the wild. Defenders of Wildlife administers a compensation trust that provides economic compensation to ranchers for wolf depredation of cattle, sheep, and other livestock. The AZA Mexican Wolf SSP captive breeding program continues to support the reintroduction by producing wolves for release to the wild and conducting research and public education programs. The captive breeding program has expanded to 47 AZA and non-AZA facilities housing more than 300 wolves (Siminski and Spevak 2008); it has received national commendation for its commitment to the conservation of the Mexican wolf (AZA 2008).

On a daily basis, management of the reintroduction project may include wolf releases and translocations, monitoring, depredation response, outreach and education, research and information collecting, and other fieldwork (Brown and Parsons 2001). Wolves from the captive population are selected for release to the wild based on several factors, including their genetic makeup, reproductive performance, behavior, physical suitability, and overall response to the adaptation process in pre-release facilities (USFWS 2006a). An Interagency Field Team (IFT), consisting of field staff from the six lead agencies, carries out the majority of the daily on-the-ground activities, with oversight and planning that has been carried out by AMOC, an oversight committee of management-level staff from the six lead agencies. Management activities are guided by 26 Standard Operating Procedures (SOPs) developed pursuant to the MOU (USFWS 2009: Blue Range Wolf Reintroduction Project). Based on litigation and the settlement agreement described above, SOP 13 is no longer in effect, and a future collaboration framework will continue to involve partners in managing Mexican wolves. The IFT produces an annual report that provides information and statistics on the status of the Blue Range population. The Service combines the IFT's report with additional updates related to the Mexican Wolf Recovery Program, such as the status of the captive breeding program, research projects, recovery planning, and litigation, for Mexican wolf recovery progress reports.

Summary statement: The AZA Mexican Wolf SSP provides captive-bred wolves for release to the BRWRA. A wild source population of Mexican wolves no longer exists.

Summary statement: The Mexican Wolf Blue Range Reintroduction Project is an interagency effort with Federal, State, County, and Tribal leadership. Based on recent litigation, revisions to the collaboration framework among these agencies need to be established; however, the Service remains committed to involving partners in the management and recovery of Mexican wolves.

As of December 2009, the Blue Range population consisted of a minimum of 42 wolves and two breeding pairs (USFWS 2009: Population Statistics) (Table 1). Between 1 and 21 wolves have been released into the Primary Recovery Zone every year since 1998, with the exception of 2005, 2007, and 2009 in which no wolves were released. The growth of the population from its initial end-of-year count of 4 wolves in 1998 to a minimum of 42 wolves today is attributed to these releases and to natural reproduction, the latter of which is a positive sign that natural population functions are occurring (AMOC and IFT: TC-11).

The population projections in the FEIS have provided the benchmark against which the progress of the Blue Range population's growth is measured. Between 1998 and 2003, the Blue Range population tracked fairly closely to FEIS projections for population count, reaching (a minimum of) 55 wolves in 2003, but was consistently below the FEIS's estimated number of breeding pairs. The population decreased significantly in 2004-2005 and then rebounded to a high of 59 wolves in 2006, the year in which the FEIS projected the population target of 100 would be met. The population decreased to 52 wolves in 2007, where it remained through 2008, with the number of breeding pairs decreasing annually from seven pairs in 2006 to two pairs in 2008 (USFWS 2009: Population Statistics) (Table 1). In 2009, the population decreased again to 42 wolves, with the number of breeding pairs remaining constant at 2. Thus, in the last six years the growth of the Blue Range population has been unsteady, hovering around the halfway point of the population target, and consistently falling significantly short of the FEIS predictions for number of breeding pairs.

Monitoring and evaluation of the reintroduction have been on-going since its inception, closely tracking progress in achieving the population target. Initial observation of the population from 1998-2000 found that most of the captive-bred wolves that were released into the BRWRA were successfully establishing home ranges, breeding, and exploiting native prey, alleviating some tension over the use of inexperienced wolves (Brown and Parsons 2001). Management response to boundary violations of wolves leaving the BRWRA, and to livestock depredation, necessitated a high number of removals that slowed colonization. The "inexperience" of the reintroduced wolves, however, did not seem to be a causative factor in the high removal rate, as most of the boundary violations were thought to be dispersing yearlings. The majority of depredations were caused by two wolf packs with territories in areas with year-round livestock grazing, where deer, rather than elk, were the primary prey source. Illegal shooting of four wolves in 1998 also slowed the initial growth of the population. Program personnel hypothesized that wolves that survived their first year would be less vulnerable to poaching, as wolves' wariness of humans seemed to increase after release (Brown and Parsons 2001). Challenges for the continuing Mexican wolf reintroduction, as seen after its first few years, included the intense management response necessary to address boundary violations, wolf-livestock interactions, the unknown consequences of limited genetic diversity, and sociopolitical acceptance of the reintroduction (Brown and Parsons 2001).

Following these initial observations, two formal agency reviews of the reintroduction project were conducted. As stipulated in the Final Rule, the Service was required to review the reintroduction project at three and five years after its inception to determine whether the reintroduction should continue, or be modified or terminated (63 FR 1752-1772, January 12, 1998). The 3-Year Review assessed the progress of the reintroduction from its inception to 2001. The technical component of the 3-Year Review, commonly referred to as the Paquet Report, was conducted by four independent (non-agency) gray wolf experts. They analyzed the establishment of home ranges in the recovery area, wild reproduction, wolf mortality levels, wolf population growth, prey adequacy, livestock depredation control, and threats to human safety. They conducted their analysis based on three years of data from the reintroduction, recognizing this short-term data forced them to speculate on many biological issues and rely on the best information available regarding wolf conservation (Paquet et al. 2001: 3).

Paquet et al. (2001) found that continuation of the population's documented reproduction and survival rates would result in slower progress achieving the population target of at least 100 wolves than estimated during the planning of the reintroduction. They concluded that several factors were ultimately hindering the biological success of the project: 1) the small size of the Primary Recovery Zone, which limited the establishment phase of the project by constraining the number and location of wolves that could be released; 2) the requirement that wolves stay within the BRWRA, which did not allow for natural dispersal movements; and, 3) the Service's objective to establish a population of at least 100 wolves, which was not deemed an adequate size for long-term viability (Paquet et al. 2001: 60-61). To address these issues, Paquet et al. (2001) recommended the Service initiate a recovery team to revise the 1982 Mexican Wolf Recovery Plan, modify the Final Rule to allow initial releases into the Gila National Forest, and allow wolves to establish territories outside of the BRWRA. They also made recommendations relating to management, outreach, and education to improve the efficacy of the project.

The 5-Year Review evaluated the reintroduction from 1998 to 2003. Some aspects of the project were analyzed through 2005, specifically follow-up to questions identified in the 1998 Mexican Wolf Interagency Management Plan (Parsons 1998), recommendations from the 3-Year Review, recommendations from the Arizona-New Mexico independent review of the 3-Year Review that was directed by Congress (AGFD and NMDGF 2002), "Commission Directives" to the State Wildlife Agencies of Arizona and New Mexico (see AMOC and IFT 2005, Attachment 1), and public comments received during the 5-Year Review process in 2005. AMOC, the IFT, and a socioeconomic consulting firm conducted the review.

In the Technical Component of the Review, which addressed the biological progress of the project, AMOC concluded that progress toward establishment of a population of at least 100 wolves was generally proceeding in line with projections from the FEIS. However, they also recognized that guidelines in the Final Rule requiring removal of wolves that establish home ranges outside of the BRWRA, or at landowner's request, are contrary to normal wolf movements, resulting in higher levels of wolf releases and removals than projected in the FEIS. Further, they found that wolves spending a greater proportion of their lives in the wild are more likely to be successful, and therefore wolves ought to be translocated, rather than permanently removed, after their first removal event except in extreme situations (AMOC and IFT: TC-24). Fourteen (of 37) recommendations in the 5-Year Review addressed the need for further analysis of potential modification of the Final Rule, including expansion of external boundaries, expansion of a recovery zone designated for release of wolves, additional provisions for harassment and take of wolves, creation of an incentives program to mitigate wolf nuisance and livestock issues, analysis of social and economic impacts associated with any MWEPA modifications under consideration, and provisions for another review of the reintroduction project in 2009-2010. The remaining recommendations dealt with management issues related to information gathering techniques and public access to data; ongoing advisory needs; annual planning, including staffing, training, and budgeting; field techniques; law enforcement; outreach, public involvement, and education; and private property incentives (AMOC and IFT: ARC).

Following the completion of the 5-Year Review in 2005, the Service determined that the reintroduction should continue, and acknowledged that modifications to the Final Rule were necessary (USFWS 2006b).

The progress of the reintroduction has also been evaluated in IFT annual reports. Since the 5-Year Review, the lead agencies have acknowledged in these reports that the population is lagging behind the projections of the FEIS, citing the high mortality and removal rates of the population as responsible for this trend (USFWS 2005:27) and concluding that management action is needed to support population growth (AGFD et al. 2007:13, AGFD et al. 2008).

Summary statement: At the end of 2009, the minimum population count of the Blue Range population was 42 wolves and 2 breeding pairs. After an initial period of annual population increase from 1998-2003, the population has oscillated in size over the next 6 years, hovering around the halfway point of the population target of (at least) 100 wolves.

Summary statement: Following completion of the 5-Year Program Review in 2005, the Service determined that reintroduction should continue and agreed that modification to the Final Rule may be necessary.

<u>State and International Regulatory Protection in the Southwestern United States and Mexico</u>

In addition to its listed status under the ESA, the gray wolf is also protected under State wildlife statutes in the Southwest and Mexico. The gray wolf is managed as a species of Special Concern and is identified as a Species of Greatest Conservation Need (endangered) in Arizona (Wildlife of Special Concern in Arizona 1996), and listed as endangered in New Mexico (Wildlife Conservation Act, 17-2-37 through 17-2-46 NMSA 1978) and Texas (Texas Statute 31 T.A.P). Wolves are considered “protected wildlife” in Utah; they cannot be harvested unless the Wildlife Board establishes an open season for harvest (Utah Code Annotated, Title 23). The gray wolf is not included on Utah’s Sensitive Species List, as the species is not considered a resident in Utah at this time and because the ESA provides protection. Wolves are listed as endangered by Colorado (Colorado Revised Statues 33-2-105, "Nongame, Endangered, or Threatened Species Conservation Act", Title 33). Mexico formally recognized the Mexican wolf as an endangered subspecies under the Norma Oficial Mexicana NOM-059-ECOL-1994, a Mexican Federal law protecting wildlife, and the Mexican wolf subspecies continues to be protected under the Ley de Vida Silvestre (2000), Norma Oficial Mexicana NOM-059-ECOL-2001 (2002). The gray wolf is not listed or protected by State law in Oklahoma.

Status and Implications of Gray Wolf Recovery in the Northern Rockies and Great Lakes for the Southwest

The progress of the Service's three gray wolf recovery programs has been markedly different among the Great Lakes, Northern Rockies, and Southwest. This is not particularly surprising, given the variety of circumstances and policy decisions affecting each program over time. While the Mexican wolf recovery program has relied on the intensive approach of captive breeding and reintroduction, the Great Lakes and Northern Rockies wolf recovery programs have relied on using translocated wolves from source populations in Canada (Northern Rocky Mountains only), natural recolonization of wolves from source populations, and natural population growth. In addition to a number of differences between these areas and the Southwest, including land status and size of the recovery areas, both programs were guided by recovery plans with recovery criteria that were revised and refined over time as relevant new information was gathered (see USFWS 1992 and 72 FR 6051-6103, February 8, 2007, for the Great Lakes, and USFWS 1987; USFWS 1994; Fritz and Carbyn 1995; Bangs 2002 and 74 FR15123-15188, April 2, 2009, for the Northern Rockies). Because the Mexican wolf reintroduction project is conducted under the umbrella of the Service's gray wolf recovery programs, recent efforts to delist the gray wolf due to recovery in the Great Lakes and Northern Rockies are germane to the reintroduction and recovery of the Mexican wolf.

In the Great Lakes, a population of over 3,000 wolves inhabits Minnesota, with a second population of close to 1,000 wolves inhabiting the two-state area of Michigan and Wisconsin (72 FR 6051-6103, February 8, 2007). Prior to listing, wolves had been effectively exterminated from Wisconsin and Michigan, with the exception of a small population on Isle Royale, and fewer than 1,000 wolves inhabited Minnesota (72 FR 6051-6103, February 8, 2007). With protections of the ESA in the late 1970s, gray wolves began to rebound in abundance and distribution. Today, population growth in the three-state area has leveled off, and these populations maintain connectivity to healthy gray wolf populations in Manitoba (~4,000 wolves) and Ontario (~8,000 wolves), Canada (72 FR 6051-6103, February 8, 2007).

In the Northern Rockies, a population of over 1,600 gray wolves inhabits core recovery areas in Montana, Idaho, and Wyoming (74 FR 15123-15188, April 2, 2009). Gray wolves had also been eliminated in these states prior to protection under the ESA. In the mid 1980s, natural reproduction was documented in a small population of wolves that had dispersed to northwestern Montana from Canada; this population continued to grow to its current size of over 275 wolves. In central Idaho and the Greater Yellowstone Area (which includes portions of Idaho, Montana, and Wyoming surrounding Yellowstone National Park), gray wolves were reintroduced from Canada in the mid-1990s into nonessential experimental populations (59 FR 60252-60266, November 22, 1994; 59 FR 60266-60281, November 22, 1994). By the end of 2008, the Greater Yellowstone Area population was estimated at close to 450 wolves, and the central Idaho recovery area's population was over 900. Routine dispersal has been documented among the northwestern Montana population, Idaho population, and Canadian populations. Natural dispersal into the Greater Yellowstone Ecosystem has been documented to occur at a rate of about one wolf annually or one effective migrant per generation (74 FR 15123-14188, April 2, 2009).

In recognition of the progress achieved in recovering the gray wolf in these areas, the Service has attempted to reclassify and delist wolves in the Great Lakes and Northern Rockies several times since 2003. In 2003, the Service reclassified the gray wolf into three distinct population segments reflective of the three recovery programs. This approach allowed the Service to make changes in status consistent with the recommendations of each region's recovery plan.

Soon after the 2003 reclassification, the Southwest Region of the Service convened a recovery team to develop a recovery plan and recovery criteria for the newly designated Southwestern Distinct Population Segment (SWDPS), which included the southern portions of Utah and Colorado, western portions of Oklahoma and Texas, all of Arizona and New Mexico, and the historic range of the Mexican wolf in Mexico. The recovery planning effort was intended to provide a regional gray wolf recovery plan that would supersede the 1982 Mexican Wolf Recovery Plan and provide context for the Blue Range reintroduction in terms of the wolf abundance and distribution necessary for recovery in the Southwest. However, the 2003 reclassification rule was vacated and remanded to the Service in 2005 (see Defenders of Wildlife v. Norton, 03-1348-JO; National Wildlife Federation v. Norton, 1:03-CV-340, D. VT. 2005). The Service believed this litigation invalidated the team's charge to develop a plan for the SWDPS, because the SWDPS was no longer a listed entity, but was rather encompassed in the listing of C. lupus range-wide in the lower 48 United States. The Service thus put the recovery planning process on hold while the agency determined how to respond.

Within a few years, the Service revisited the issue with proposals to delist DPS's for the gray wolf in the Great Lakes and Northern Rockies, this time in separate rules (72 FR 6051-6103, February 8, 2007; 73 FR 10513-10560, February 27, 2008; 74 FR 15123-15188, April 2, 2009; 74 FR 105070-15123, April 2, 2009. These actions have been challenged in the courts and most determinations have been remanded and vacated, save the most recent Northern Rocky Mountains delisting where a decision is expected in spring 2010. Thus, the gray wolf remains listed as endangered across most of the lower 48 states, except in: (1) Minnesota, where it is listed as threatened; (2) delisted portions of the Northern Rocky Mountain DPS including Montana, Idaho, eastern Washington, eastern Oregon, and northeastern Utah; and (3) the Wyoming portion of the Northern Rockies DPS where wolves are considered nonessential, experimental, and portions of Arizona, New Mexico, and Texas where wolves are considered nonessential, experimental.

All wolf status designations are geographically based. Thus, in the unlikely event that a gray wolf from another population wanders into the southwest, it would be governed by the protective status for wolves in that area (endangered or nonessential, experimental). The converse is also true should any Mexican wolves disperse beyond the nonessential experimental reintroduction area boundaries (i.e., the wolf would likely enter areas listed and protected as endangered).

Litigation over the Service's 2003 gray wolf reclassification resulted in a temporary cessation of recovery planning in the Southwest, as the agency revisited its approach to gray wolf reclassification and delisting in the Great Lakes and Northern Rockies. The agency has demonstrated its intent to move forward with reclassification and delisting of independent DPS's in these areas for several years, but has not resumed the recovery planning effort in the Southwest. The Southwest Region therefore remains without the guidance of an up-to-date gray wolf recovery plan. Objective and measurable recovery criteria are still needed to provide context for the subspecific Mexican wolf reintroduction and recovery effort within remaining gray wolf listed range.

Summary statement: All wolves occurring in the Great Lakes region are currently protected as endangered, except in Minnesota where they are listed as threatened.

Summary statement: In 2009, the Service identified a distinct population segment (DPS) of the gray wolf (*Canis lupus*) in the Northern Rocky Mountains (NRM) of the United States and revised the List of Endangered and Threatened Wildlife by removing gray wolves within NRM DPS boundaries, except in Wyoming. The NRM gray wolf DPS encompasses the eastern one-third of Washington and Oregon, a small part of north-central Utah, and all of Montana, Idaho, and Wyoming. Until Wyoming revises its regulatory framework and is approved by the Service, wolves in Wyoming will continue to be managed as an experimental population under the ESA. This decision was published April 2, 2009, and became effective May 4, 2009. This decision has been challenged in Montana and Wyoming District Courts. A legal ruling is expected in spring of 2010.

Summary statement: The Mexican wolf recovery program in the Southwest operates in absence of an up-to-date recovery plan that would situate the BRWRA population as an integral component of regional and national gray wolf recovery.

GRAY WOLF BIOLOGY AND ECOLOGY

Taxonomy and Range

The gray wolf, *Canis lupus*, is a member of the dog family *(Canidae: Order Carnivora).* The genus *Canis* also includes the red wolf (*C. rufus*), dog (*C. familiaris*), coyote (*C. latrans*), several species of jackal (*C. aureus*, *C. mesomelas*, *C. adustus*) and the dingo (*C. dingo*) (Mech 1970). Type localities of previously recognized subspecies are documented in Young and Goldman (1944); the type locality of *Canis lupus baileyi* Nelson and Goldman is Colonia Garcia, Chihuahua, Mexico.

It is likely that, with the possible exception of the wolf of southeastern Canada and northeastern United States (Wilson et al. 2003), all gray wolves evolved from the small, early canids that were widespread in North America and the Old World during the Pliocene, some 2 to 4.5 million years ago (Nowak 2003). The gray wolf likely evolved in Eurasia from wolves that crossed into Eurasia from North America. A branch of these wolves (that is, *Canis lupus*) then reinvaded the New World during the middle Pleistocene (around 300,000 years ago) via the Bering Strait land bridge (Wayne et al. 1992, Brewster and Fritts 1995, Nowak 1995, Parsons 1996, Nowak 2003: Table 9.2). It is hypothesized that waves of gray wolf migration likely occurred in response to changing glacial ice patterns and openings in the Bering Sea (Nowak 1995, Nowak 2003, Wayne and Vilá 2003). Once in the New World, wolves dispersed southward and eastward, gradually spreading across the continent (Parsons 1996, Nowak 2003).

Twenty-four subspecies of gray wolf have been described in North America (Hall and Kelson 1959). Five of these subspecies occurred in the southwestern United States and Mexico: *C. l. baileyi, C. l. mogollonensis, C. l. monstrabilis, C. l. nubilus,* and *C. l. youngi*. Hall (1981) described *C. l. baileyi*'s range as including only a small portion of extreme southwestern New Mexico and southeastern Arizona. However, a taxonomic revision proposed by Bogan and Mehlhop (1980, 1983) lumped *C. l. mogollonensis* and *C. l. monstrabilis* with *C. l. baileyi*, thereby extending *C. l. baileyi*'s range to northern Arizona and central New Mexico, and recognizing only three southwestern subspecies, *C. l. baileyi*, *C. l. youngi*, and *C. l. nubilis*. The Service adopted the findings of Bogan and Mehlhop in the 1982 Mexican Wolf Recovery Plan, thus supporting reintroduction of *C. l. baileyi* north of *C. l. baileyi*'s range as originally conceived by Young and Goldman (1944) and Hall and Kelson (1959).

In a subsequent reclassification of North American gray wolves, Nowak (1995) proposed reduction of the number of recognized subspecies from 24 to 5, recognizing *C. l. arctos, C. l. baileyi, C. l. lycaon, C. l. nubilus,* and *C. l. occidentalis* as subspecies. In this classification, *C. l. baileyi* was recognized as a subspecies, but *C. l. mogollonensis* and *C. l. monstrabilis* were grouped with *C. l. nubilus*. The classifications proposed by Hall and Kelson (1959), Bogan and Mehlhop (1983), and Nowak (1995) were based on comparisons of morphological characteristics, primarily skull measurements. Parsons (1996) added knowledge of dispersal patterns to the historic range of *C. l. baileyi* proposed by Nowak (1995) and concluded that historically Mexican wolves ranged as far north as central New

Mexico and east-central Arizona. The Service adopted the historic range proposed by Parsons (1996) for *C. l. baileyi*, a 200-mile northward extension of Nowak's range for *C. l. baileyi*, and included it in the FEIS (USFWS 1996).

This history highlights the disagreement in North America over the use of sub-specific nomenclature to describe geographic variation among gray wolf populations across their historically vast range (Brewster and Fritts 1995, Nowak 2003). As Brewster and Fritts (1995:355) explained, "Inherent in most recent thinking [of subspecies definition] is the idea that members of a subspecies should be more closely related to one another than to individuals of another subspecies, and further, that geographic or ecological isolation (e.g., islands, mountain ranges separated by deserts, plains separated by mountain ranges) has caused gene flow between populations to be restricted and allowed differentiation of characteristics." Difficulty in grouping wolves into subspecies arises due to the tendency of gray wolves to move significant distances across the landscape. During these movements, dispersing wolves may come into contact with near or distant wolf populations, potentially resulting in high rates of gene flow between populations and limited genetic differentiation among populations (Wayne et al. 1992, Roy et al. 1994, Vilá et al. 1999).

Wolves' dispersal behavior led to the conclusion that wolves existed historically in intergradations across the North American landscape (Young and Goldman 1944, Mech 1970, Brewster and Fritts 1995, Leonard et al. 2005). Mech (1970: 30) commented that, "Wherever subspecies meet, their characters tend to blend as a result of interbreeding, or intergradation…". Under optimal conditions wolves' dispersal capabilities exceed 500 miles (Fritts 1983, Boyd et al. 1995), thus these zones of subspecies intergradation were likely hundreds of miles wide (Brewster and Fritts 1995). Given this information, the difficulty in describing where one subspecies' boundary begins and ends becomes apparent. As Wayne and Vilá (2003: 223) recently stated, "the division of wolves into discrete subspecies and other genetic units may be somewhat arbitrary and overly typological (conforming to a specific ideal type). In reality, wolves are better viewed as a series of intergrading populations having subtle or undetectable patterns of clinal genetic change" [continuous gradation in any trait].

In recent decades, the emergence of the field of conservation genetics has contributed significantly to understanding the gray wolf. Recent molecular genetic evidence (Leonard et al. 2005) indicates that there was considerable gene flow across the subspecies' boundaries postulated by Nowak (1995, 2003), keeping with the previous understanding that wolves naturally existed in intergradations across the landscape. More specifically, there is evidence of gene flow across the recognized boundary of *C. l. baileyi*. Analyses of historic specimens demonstrate that the gray wolves that inhabited northern Arizona, southern and central Utah, northern New Mexico, and southern and central Colorado had genetic markers now associated with the Mexican wolf. In other words, Mexican wolves likely intergraded with other gray wolves at the northern extent of their range (Leonard et al. 2005). This research shows that within the time period that the historic specimens were collected (1856-1916) a northern clade (i.e., group that originated from and includes all descendents from a common ancestor) haplotype was found as far south as Arizona, and individuals with southern clade haplotypes (associated with the Mexican wolf) occurred as far north as Utah and Nebraska.

Leonard et al. (2005) interpret this geographic distribution of haplotypes as indicating gene flow was extensive across the subspecies' limits during this historic period.

Based on genetic analyses, it has also been determined that the genetic makeup, or genotype, of all gray wolves is very similar (Wayne et al. 1992). Mitochondrial DNA analysis has suggested that, with a few exceptions, a genetic basis for the previous sub-specific designations of gray wolf may not exist (Wayne et al. 1995). Molecular genetics analyses, however, provide indisputable evidence that the Mexican wolf has distinct genetic attributes differing from other North American gray wolves (Wayne and Vilá 2003), thus supporting earlier morphological characterization of the Mexican wolf as a distinct subspecies (Wayne et al. 1992, García-Moreno et al. 1996, Hedrick et al. 1997, and see Nowak 2003).

The origins of the distinct genetic traits and morphological features of the Mexican wolf are uncertain. It is hypothesized that *C. l. baileyi* represents one of the earliest waves of migration of the gray wolf onto the continent (Wayne and Vilá 2003). *Canis lupis baileyi* may have subsequently experienced random genetic drift during a period of isolation from other wolf populations as expansion and retraction of glacial ice patterns caused ephemeral boundaries to dispersal and continent-wide population flux in gray wolf abundance (Roy et al. 1994, Wayne et al. 1995, Vilá et al. 1999). Another possible explanation is based on the knowledge that morphological differences are not necessarily indicative of long periods of geographic isolation and may only indicate intense natural selection on particular physical features (Wayne et al. 1992). Geographic variations in body size and pelage, therefore, could be a result of selection for differences in habitat or prey type, resulting in differentiation despite otherwise high levels of gene flow (Wayne et al. 2004). There is no scientific certainty whether drift or selection caused *C. l. baileyi*'s distinctiveness.

Summary statement: Integration of ecological, morphological, and genetic evidence supports several conclusions relevant to the southwestern United States regarding gray wolf taxonomy and range. First, there is agreement that the Mexican wolf is distinguishable from other gray wolves based on morphological and genetic evidence. Second, recent genetic evidence continues to support the observation that historic gray wolf populations existed in intergradations across the landscape due to gene flow as a result of their dispersal ability. Third, evidence suggests that the southwestern United States (southern Colorado and Utah, Arizona, and New Mexico) included multiple wolf populations distributed across a zone of intergradation and interbreeding, although only *C. l. baileyi* inhabited the southernmost extent.

<u>Physical Description and Life History</u>

Gray wolves often vary considerably in size, although males typically weigh between 36-55 kg (80-120 lbs), are 1.5 to 2 m (5-6.5 ft) long from tip of nose to tip of tail, and 66 to 81 cm (26-32 in) high at the shoulder. Males are typically 15-20 percent larger than females in weight and length. Gray wolves exhibit significant variety in pelt color; the most commonly observed pelt is a mottled charcoal gray, but pelt color can range from white, cream, brown and red, to dark gray and black (Mech 1970). Individual wolves may exhibit any or all of these colors (Fuller 2004).

The Mexican wolf (Figure 2) is the smallest extant gray wolf in North America; adults weigh 23-41 kg (50-90 lbs) with a length of 1.5-1.8 m (5-6 ft) and height at shoulder of 63-81 cm (25-32 in) (Young and Goldman 1944, Brown 1983). Mexican wolves are typically a patchy black, brown to cinnamon, and cream color, with primarily light underparts (Brown 1983); solid black or white Mexican wolves do not exist as seen in other North American gray wolves (USFWS 2008).

Basic descriptive life history information is well documented for gray wolves, although less so for the Mexican wolf. In the wild, wolves typically live 4 to 5 years, although they can reach 13 years (Mech 1988). They reach sexual maturity at two years of age (Mech 1970). Wolves have one reproductive cycle per year, and females are capable of producing a litter of pups, usually four to six, each year (Mech 1970). Litters are born in spring in a den or burrow that the pack digs (Mech 1970, Packard 2003). Pups weigh about one lb (0.5 kg) at birth (Mech 1991), and remain inside the den for at least four weeks, during which time their eyes open and the animals learn to walk (Packard 2003). Pup mortality during the denning period is difficult to document due to lack of access to den sites (Fuller et al. 2003).

Documentation in the BRWRA of wild-born wolves breeding and raising pups has been made for 8 years in a row (2001-2008), and in 2008 approximately 87 percent of wolves in the Blue Range population were wild-born (AGFD et al. 2008). In the wild, Mexican wolf pups are generally born between early April and early May (AMOC and IFT 2005: TC-6). Pup counts are conducted opportunistically after the denning period, but prior to October, at which point Mexican wolf pups are difficult to distinguish from adults (AMOC and IFT 2005: TC-6). Average litter size has been estimated at 2.1 pups in the reintroduced population based on data collected for the 5-Year Review, which is noticeably smaller than Mexican wolf litters in captivity (4.6 pups/litter) (AMOC and IFT: TC-17-18), gray wolf litters elsewhere (AMOC and IFT: TC-12, see Fuller et al. 2003), or the historical litter sizes of wild Mexican wolves reported by McBride (4.5 pups) (1980). Note that red wolf litter sizes (2.8 pups/litter) during their initial restoration are similar (Phillips et al. 2003).

Recent analyses of the captive and reintroduced populations suggest the low litter sizes observed in the reintroduced population are partially the result of inbreeding (Fredrickson et al. 2007). In the Blue Range population, the number of pups observed in packs producing cross-lineage pups (those descended from outbred F1 wolves created by the merging of the founding lineages) was 52 percent greater than packs producing pure McBride wolves, demonstrating that inbreeding has negatively affected litter sizes and that fitness was greatest in the less-inbred cross-lineage wolves (Fredrickson et al. 2007). Several other hypotheses have been offered to explain small litter sizes in the reintroduced population: 1) wolves may be limited by the amount of vulnerable prey due to winter snow patterns; 2) litter sizes may be an historical adaptation to the environment; or, 3) wolves released from captivity may be less capable of exploiting vulnerable prey, potentially further affected by frequent management that decreases their ability to fully exploit their home ranges (AMOC and IFT: TC-18)). Conclusive data have not been gathered to support or refute these hypotheses. Further, early pup mortality may affect the litter sizes observed in the wild. Mexican wolf females from the wild population brought into captivity before or shortly after whelping pups had an average litter size matching that of the captive population (4.6 pups/litter, n = 6), suggesting that more Mexican wolf pups are born than are observed in the wild. Since litter size at birth and early pup mortality are unknown (AMOC and IFT 2005: TC-18), small litter sizes or low pup recruitment could explain the small number of pups observed during pup counts.

During the first few months of life, gray wolf pups are gradually weaned from their parents, transitioning from nursing to feeding on semi-liquid regurgitated food provided by adult wolves at the den site, to consuming solid food. During this period, pups grow rapidly, likely due to high prey availability during summer months. Pup survival is typically highest in those areas of high prey availability (Fuller et al. 2003). Wolves are referred to as pups up to one year of age and yearlings when one to two years of age (Packard 2003).

Juveniles begin hunting with adults when 4 to 10 months old (Packard 2003), remaining with their family until they disperse to establish a new territory. Wolves exploit their prey by hunting in packs. Adult wolves typically experience a feast or famine existence, gorging on freshly killed prey after successful hunts and subsequently able to survive for days with low food intake (Peterson and Ciucci 2003). Wolves buffer these extremes of food availability by burying food for later consumption (Peterson and Ciucci 2003). Wolves also use a variety of prey and habitat types, which helps to ameliorate fluctuations in food availability (Mech 1991, Weaver et al. 1996). Kill rates of individual wolves vary significantly, from 0.5 to 24.8 kg/wolf/day (1 to 50 lbs/wolf/day), based on a variety of factors such as prey selection, availability and vulnerability of prey, and the effects of season or weather on hunting success (Mech and Peterson 2003, see Table 5.5). Minimum daily food requirements of an adult gray wolf have been estimated at 1.4 kg/wolf (3 lbs/wolf), or about 13 adult-sized deer per wolf per year, with the highest kill rate of deer reported as 6.8 kg/wolf/day (15 lbs/wolf/day) (Mech and Peterson 2003). Prior to the Blue Range reintroduction, it was estimated that Mexican wolves would need to kill 1 mule deer every 12-13 days or 1 white-tailed deer every 8-9 days (Johnson et al. 1992). Wolves also scavenge on carcasses when available (Peterson and Ciucci 2003).

Wolf survival rates vary seasonally, as shifts in prey availability occur (Fuller et al. 2003). Annual survival rate of yearling and adult gray wolves is estimated at 0.55 to 0.86 (Fuller et al. 2003: Table 6.6). Documented causes of death include starvation, disease, human-caused mortality, and interactions with other wolves or predators (Ballard et al. 2003, Fuller et al. 2003). In the Blue Range population, causes of mortality have been largely human-related, including vehicle collision, illegal gunshot, lethal control, and capture complications, although dehydration, brain tumor, infection, snakebite, disease, mountain lion attack, and unknown causes have also been documented (AMOC and IFT 2005: TC-12). Between 1998 and June 1, 2009, illegal gunshot (31 of 68 deaths) and vehicle collision (12 of 68 deaths) were the two most prevalent causes of death (USFWS 2009: Population Statistics). Wolves are sometimes able to compensate for high levels of mortality with high levels of reproduction (Weaver et al. 1996); this does not appear to be occurring in the Blue Range population given current population trends, although possible low pup recruitment could be masking such a trend (USFWS 2009: Population Statistics). In 2008, the annual survival rate of the Blue Range population was 0.60 (or a corresponding failure rate of 0.40, which includes both mortality and management removal of wolves), a rate considered too low for natural population growth (AGFD et al. 2008).

Pack Formation and Movements

Wolves are social animals that live in hierarchical families, referred to as packs. Wolf packs consist of a breeding pair (formerly "alpha" (Packard 2003)) and their subordinate pup and yearling offspring (Mech 1970) although many variations of this typical pack structure have been observed (Mech and Boitani 2003). The minimum number of breeding pairs observed in the Blue Range population is documented by the IFT in the annual end-of-year population count. "Breeding pair" as defined in the Final Rule, "means an adult male and an adult female wolf that have produced at least two pups during the previous breeding season that survived until December 31 of the year of their birth" (50 CFR 17.84(k) (15). Over the span of the reintroduction, the number of breeding pairs meeting the Final Rule definition has ranged from zero to seven pairs (USFWS 2009: Population Statistics). During two years, the Service interpreted the Final Rule to include any two adult wolves associated with any two surviving pups at the end of the year, even if the pair did not breed (e.g., one member of a breeding pair is replaced by a new wolf that raises pups born to the former pair). This interpretation resulted in the number of breeding pairs counted being higher than if only the pairs that produced pups that survived until the end of the year were counted (AGFD et al. 2006, AGFD et al. 2007). Additional breeding events occur within the population, but do not meet the Final Rule definition for a breeding pair. For example, in 2008, wild-born, wild-conceived pups were produced by seven packs (AGFD et al. 2008). Pack size in the Blue Range population between 1998 and 2003 ranged from 2 to 11 (mean = 4.8) wolves (AMOC and IFT 2005: TC-12). Bednarz (1988) estimated historic Mexican wolf pack size as two to eight animals.

To secure food, water, and shelter, a pack establishes an area, or territory, that is maintained by the breeding pair through scent-marking (Peters and Mech 1975), howling (Harrington and Mech 1983), and direct defense (Mech and Boitani 2003). Minimum territory size is the area in which sufficient prey exist to support the pack (Fuller et al. 2003), so territories vary in size depending on prey density or biomass and pack size. Bednarz (1988) predicted that reintroduced Mexican wolves would likely occupy territories ranging from 200-400 square kilometers (km^2) (approximately 78 to 158 square miles (mi^2)), and hypothesized that Mexican wolf territories were historically comparable in size to those of small packs of northern gray wolves, but possibly larger, due to habitat patchiness (that is, mountainous terrain that included areas of unsuitable lowland habitat) and lower prey densities associated with the arid environment. Between 1998 and 2003, home range size of 19 monitored packs in the Blue Range population averaged 462 km^2 +/- 63 km^2 (182 mi^2 +/- 24 mi^2) (AMOC and IFT 2005: TC-10). Similarly, in 2008, home range size of 11 packs exhibiting territorial behavior averaged 505 km^2 (195 mi^2), varying in size from 155 km^2 to 1302 km^2 (60 mi^2 to 503 mi^2).

Wolf packs move within their respective territories as they forage and defend their territories (Mech and Boitani 2003). Wolves' daily movements vary in response to the distribution, abundance, and availability of prey. Seasonal movements vary as well: while rearing pups, adult wolves leave the den, returning throughout the day to care for their young. When pups are old enough to travel with adults, packs become nomadic, traveling throughout the territory, sometimes returning to rendezvous sites (Mech and Boitani 2003). Daily pack movements of less than 10 miles per day to over 40 miles in a 24-hour period have been documented in different wolf populations in different seasons (see Mech and Boitani 2003: 32).

In addition to movements within territories, wolf travels typically include dispersal movements (Mech and Boitani 2003). An individual wolf, or rarely a group, will disperse from its natal pack in search of vacant habitat or a mate; dispersers are typically younger wolves of 9 to 36 months of age (Packard 2003). A yearling might make several dispersal forays before completely disassociating from the family (Messier 1985). These dispersals may be short to a neighboring territory, or may be long to find a mate and establish a territory. Dispersal of more than 1092 km (655 mi) has been documented in northern populations (Wabakken et al. 2007). Between 1998 and 2003, 45 wolf dispersals (natural dispersals and post-release movements) were documented in the Blue Range population, with an average distance of 87 km +/- 10 km (54 mi +/- 6 mi). This is likely an under-representation of true movement distances, due to management response required by the nonessential experimental-population designation when wolves disperse outside of the BRWRA. Wolves in the BRWRA primarily dispersed northwestward or southeastward, in the direction that mountain ranges lie within the area (AMOC and IFT 2005: TC-13). Dispersing gray wolves usually travel alone and tend to have a high risk of mortality (Fuller et al. 2003). In the Blue Range population, 12 known mortalities were documented in association with dispersal 1998-2003 (including natural dispersal and movements directly after release to the wild) (AMOC and IFT 2005: TC-14). Wolves that disperse and locate a mate and an unoccupied patch of suitable habitat usually establish a territory (Rothman and Mech 1979, Fritts and Mech 1981).

Ecology and Habitat Description

Wolves are top predators. They are generally not habitat specific and are considered to have fairly broad ecological capabilities (Wayne et al. 2004) and flexibility in using different prey and habitats (Mech 1991). Historically, wolves occupied every habitat in the northern hemisphere that supported populations of large ungulates (Mech 1991). The gray wolf hunts in packs, primarily pursuing medium to large hoofed mammals, potentially supplementing its diet with small mammals (Mech 1970). Wolf density is positively correlated to the amount of ungulate biomass available and the vulnerability of ungulates to predation (see Fuller et al. 2003).

Wolves may play a variable role in ungulate population dynamics depending on the predator-prey interaction and the relative importance of other ecosystem factors (Boutin 1992, Gasaway et al. 1993, Messier 1994). Ungulates employ a variety of defenses against predation (e.g., aggression, migration), and wolves are frequently unsuccessful in their attempts to capture prey (Mech and Peterson 2003). Generally, wolves tend to kill less-fit prey (e.g., young, old, injured) that are predisposed to predation (Mech and Peterson 2003). Wolves may reduce prey numbers, especially during adverse conditions, but only in extreme circumstances have they been documented exterminating a prey population, and then only in a relatively small area (Mech and Peterson 2003).

Wolves may also impact ecosystem diversity beyond that of their immediate prey source in areas where their abundance affects the distribution and abundance of other species (sometimes referred to as "ecologically effective densities" (Soule et al. 2003)) (Soule et al. 2005). This may occur through two mechanisms: 1) wolf predation may decrease the population of an herbivore that otherwise would competitively exclude other herbivores; and, 2) wolf predation on an herbivore may result in changes (e.g., in diversity, population size) to lower tropic levels, cascading to the bottom of the food web (i.e., "trophic cascade") (Terbough et al. 1999). Such effects have been attributed to gray wolf reintroduction in Yellowstone National Park and elsewhere (e.g., Ripple and Bescheta 2003, Wilmers et al. 2003, Ripple and Bescheta 2004, Hebblewhite et al. 2005). For example, in a riparian area of Yellowstone National Park, growth of cottonwood trees and other riparian woody vegetation in several areas was suppressed by high elk browsing intensity prior to the gray wolf reintroduction. Since the reintroduction, cottonwood and woody vegetation height has increased in areas with high predation risk, demonstrating the effect a predator can have on lower tropic levels (Ripple and Bescheta 2003).

Historically, Mexican wolves were associated with montane woodlands characterized by sparsely- to densely-forested mountainous terrain and adjacent grasslands in habitats found at elevations of 1219-1524 m (4,000-5,000 ft) (Brown 1983). Wolves were known to occupy habitats ranging from foothills characterized by evergreen oaks (*Quercus* spp.) or pinyon (*Pinus edulus*) and juniper (*Juniperus* spp.) to higher elevation pine (*Pinus* spp.) and mixed conifer forests. Factors making these habitats attractive to Mexican wolves likely included an abundance of ungulate prey, availability of water, and the presence of hiding cover and suitable den sites. Early investigators reported that Mexican wolves probably avoided desert scrub and semidesert grasslands that provided little cover, food, or water (Brown 1983). Wolves traveled between suitable habitats using riparian corridors, and later, roads or trails (Brown 1983). Elevation in the BRWRA ranges from 1219-3353 m (4,000-11,000 ft), ranging from semi-desert grasslands to conifer forests, with ponderosa forests dominating the area in between (USFWS 1996).

Historically, Mexican wolves were believed to have preyed upon white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), collared peccaries (javelina) (*Tayassu tajacu*), pronghorn (*Antilocapra Americana*), bighorn sheep (*Ovis Canadensis*) jackrabbits (*Lepus spp*.), cottontails (*Sylvilagus spp.*), and small rodents (Parsons and Nicholoupolos 1995); white-tailed deer and mule deer were believed to be the primary sources of prey (Brown 1983, Bednarz 1988, Bailey 1931, Leopold 1959).

Data from the Blue Range indicate that elk are the preferred prey (Brown and Parsons 2001, Reed et al. 2006), with wolves showing a preference for calf elk over adult elk (AMOC and IFT 2005: TC-14). Mexican wolves are also feeding on adult and fawn deer, unknown wild ungulates, cattle, small mammals, and occasionally birds (Reed et al. 2006). Scat analysis suggests that Mexican wolves in the Blue Range are concentrating on the largest prey available (elk), which is atypical given that wolves typically concentrate on the smallest or easiest prey available if two or more sources of prey are present. One hypothesis for this is that during the initial stages of the reintroduction, elk were naïve to predation by wolves and were the most numerous ungulate species; a second is that study methodology may have skewed data collection in order to minimize the probability of including coyote scat (Reed et al. 2006, Carrera et al. 2008).

The FEIS estimated that a population of 15,800 elk (average density 3.7/km² or 1.4/mi^2), and 57,170 mule deer and white-tailed deer (average density 13.36/ km² or 5/mi^2) were present in the BRWRA prior to the reintroduction of Mexican wolves (USFWS 1996). Although prey densities for the entire BRWRA are not available, wolf activity in the BRWRA appears to be located in areas of high elk density, as defined by state game management units (AMOC and IFT 2005: TC-14), and no evidence of food shortage has been observed (AMOC and IFT 2005: TC-21). The difference in historic versus current prey preference may in part be due to varying interpretations of Mexican wolf range; historic accounts which considered Mexican wolf range as southern Arizona and New Mexico into Mexico reflect the prevalence of deer (and relative absence of elk) in these areas, whereas elk are common, and sometimes more numerous than white-tailed or mule deer, in the current Mexican wolf range in the BRWRA (AMOC and IFT: TC-1).

Livestock are another widely available potential source of prey for Mexican wolves in the BRWRA. Historically, records of Mexican wolf exploitation of livestock were prominent (Young and Goldman 1944, McBride 1980, Brown 1983, Bednarz 1988); this is not surprising given that such reports were made by government and private wolf control agents whose jobs focused on depredating animals (and see Gipson and Ballard 1998, Gipson et al. 1998). When the reintroduction began, sheep and cattle grazing were permitted on approximately 69 percent of the BRWRA, with about half of the allotments being grazed year-round (USFWS 1996). Program projections predicted that at the reintroduction goal of at least 100 Mexican wolves, depredation levels of 1-34 cattle per year would occur (USFWS 1996). Between 1998 and 2008, 123 confirmed cattle depredations were documented (USFWS 2004; AMOC and IFT 2005: TC-15; USFWS 2005; USFWS 2006a; AGFD et al. 2007, AGFD et al. 2008), or an average depredation rate of 26 cattle per 100 wolves per year. This depredation rate may represent an underestimate due to incomplete detection of wolf-killed cattle (Oakleaf et al. 2003). Between 1998 and 2008, 70 wolves were removed as a result of 138 confirmed depredations (123 cattle, 12 sheep, and 3 horses) (USFWS 2004; AMOC and IFT 2005: TC-15; USFWS 2005; USFWS 2006a; AGFD et al. 2007, AGFD et al. 2008; USFWS 2009: Project Statistics), or one wolf removal per 1.97 confirmed depredations.

<u>Wolves and Non-prey</u>

Wolves also interact with non-prey species. Although these interactions are generally not well documented, competition and coexistence may occur between wolves and other large, medium, or small carnivores (Ballard et al. 2003).

In the Southwest, wolves may interact with other wolves, coyotes, mountain lions (*Puma concolor*), and black bears (*Ursus americanus*) (AMOC and IFT 2005: TC-3). Aggression among wolves is typically associated with food shortages as wolves venture into neighboring territories to locate prey (Mech and Boitani 2003). Observations of wolf and coyote interactions in other regions have documented decreased coyote density in areas of high wolf density and that wolves occasionally kill or eliminate coyotes (Ballard et al. 2003). Bednarz (1988) suggested that prior to wolf extirpation, Mexican wolves excluded coyotes from many areas. A current study of Mexican wolf and coyote diets in the BRWRA shows that wolves and coyotes have similar diets consisting mainly of elk (Carrera et al. 2008). It is not known whether coyotes are scavenging elk carcasses from wolf kills or preying on elk directly, although both behaviors have been documented in other areas. It is hypothesized that this shared source of prey may cause competition between wolves and coyotes that will result in wolves killing coyotes (Carrera et al. 2008).

Bednarz (1988) also hypothesized that wolves and mountain lions interacted historically, given their overlapping habitats and shared prey source of mule deer, but suggested that wolves may have exploited gentler sloping terrain, with mountain lions hunting in steeper craggy mountainous terrain. The potential for competition between wolves and lions certainly exists in areas where spatial overlap is extensive and prey selection patterns are similar (see Kunkel et al. 1999), although differences in hunting behavior and prey vulnerability to wolves and mountain lions have been observed (see Husseman et al. 2003). One Mexican wolf death from a mountain lion attack has been recorded in the BRWRA (AMOC and IFT 2005: TC-12). Gray wolves have been known to kill black bears near their dens and to take over kill sites occupied by black bears (Ballard and Gipson 2000, Ballard et al. 2003), but interactions between Mexican wolves and black bears have not been documented. Two other Mexican wolf deaths have been attributed to predators, but identification of specific predators was not provided (USFWS 2004, USFWS 2006a, USFWS 2009: Population Statistics).

Wolf – Human Interactions

Wolves' reactions to humans include a range of non-aggressive to aggressive behaviors, and may depend on their prior experience with people. For example, wolves that have been fed by humans, habituated, or reared in captivity may be more apt to show fearless behavior towards humans than wild wolves; diseased wolves may also demonstrate fearless behavior (McNay 2002, Fritts et al. 2003). In North America, wolf-human interactions have increased in the last three decades, likely due to increasing wolf populations and increasing visitor use of parks and other remote areas (Fritts et al. 2003). Generally, wild wolves are not considered a threat to human safety (McNay 2002). An inquest jury has attributed one recent human death in Canada to wolves, although a number of wildlife experts disagree whether wolves or black bears were responsible for the death (Wikipedia 2008).

In the BRWRA, wolf-human interactions have been documented. For example, between 1998 and 2003, 33 cases of wolf-human interactions were documented in the BRWRA. The majority of these incidents (64 percent) were considered investigative searches in which wolves ignored human presence. In several cases (27 percent), wolves approached humans in a non-threatening manner, and in 3 reports wolves displayed aggressive behavior (charging) toward humans (AMOC and IFT 2005: TC-15). A majority of the interactions involved wolves recently released from captivity, suggesting that wolves released from captivity may be more prone to initial fearless behavior toward humans, despite appropriate captive management and selection criteria for release candidates (AMOC and IFT 2005: TC-22). Wolves are known to kill dogs virtually everywhere the two coexist (Fritts et al. 2003), thus the presence of dogs may provoke investigative or aggressive behavior. Dogs were present in many of the cases (including the three charges, in which the aggression appeared to focus on the dogs rather than the humans) (AMOC and IFT 2005: 22). Aversive conditioning (rubber bullets, cracker shells) or translocation or removal of the wolf was applied in all cases of wolf-human interaction. In 2008, the IFT received 37 reports of wolf sightings: 16 reports were determined to be non-wolf sightings, 13 reports were known or probable wolf sightings, four reports were of unknown or uncollared wolves, and four reports contained inadequate information to make a determination (AGFD et al. 2008). Ten cases of nuisance behavior in 2008 required management response by the IFT to address wolves in proximity to residences, campgrounds, or other areas (AGFD et al. 2008).

Humans may also be a significant source of mortality for wolves. Human-caused mortality is a function of human densities in and near occupied wolf habitat and human attitudes toward wolves (Kellert 1985, Fritts and Carbyn 1995, Mladenoff et al. 1995). Sources of mortality may include accidental incidents such as vehicle collision, or intentional incidents such as illegal shooting. In areas where humans are tolerant to the presence of wolves, wolves demonstrate an ability to persist in the presence of a wide range of human activities (e.g., near cities and congested areas) (Fritts et al. 2003). Past recommendations estimated suitable Mexican wolf habitat to occur when human density is less than 12 people per square mile (2.56 km^2), with an optimum density of less than 6 people per square mile (Johnson et al. 1992), in recognition of human-caused sources of wolf mortality. In keeping with these guidelines, the BRWRA was selected in part due to its low human population density (estimated at 2/km^2 or 0.8/mi^2 prior to the reintroduction) (USFWS 1996: Table 3-3). In the BRWRA, illegal shooting is the biggest mortality source of Mexican wolves (USFWS 2009: Population Statistics) (and see “Physical Description and Life History”, and factor (E) in “Threats to the Gray Wolf in the Southwest”).

CONSERVATION ASSESSMENT

Threats to the Gray Wolf in the Southwest

The ESA defines an “endangered species” as “any species which is in danger of extinction throughout all or a significant portion of its range” 16 U.S.C 1532(6). Similarly, a “threatened species” is “any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range” 16 U.S.C 1532(20). A species is listed as threatened or endangered if one or more of the following five factors in section 4(a)(1) of the ESA are determined to be responsible for its condition:

(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.

Subsequent 5-factor analyses are conducted periodically while a species is listed to assess its status and ensure that conservation actions are addressing current threats. Finally, a 5-factor analysis is conducted when a species is proposed for delisting due to recovery to ensure that none of the factors continue to threaten or endanger the species.

Several 5-factor analyses have been conducted for the Mexican wolf. In the initial proposal to list the Mexican wolf as endangered in 1975, the Service found that threats from habitat loss (factor (A)), sport hunting (factor (B)), and inadequate regulatory protection from human persecution (factor (D)) were responsible for the subspecies’ decline and near extinction (40 FR 17590-17591, April 21, 1975). In the 1978 listing of the entire gray wolf species as endangered throughout the coterminous United States and Mexico (except for Minnesota, where it was classified as threatened), the Service identified the same threats (43 FR 9607-9615, March 9, 1978).

In 2003, when the Service reclassified the gray wolf into three distinct population segments, the agency assessed threats to the Mexican wolf as a part of the SWDPS (68 FR 15804-15875, April 1, 2003). The reclassification rule stated that habitat destruction or modification (factor (A)) was not currently considered a threat or deterrent for restoration of southwestern (Mexican) gray wolves based on the 1982 Mexican Wolf Recovery Plan which stated that sufficient habitat existed at that time to support current recovery plan objectives. “Take” for commercial or recreational purposes (factor (B)) was not considered a threat. 16 U.S.C 1532(19). Diseases and parasites (factor (C)), which are known to be an important consideration in wolf conservation, were not known to be significant factors in the decline of the Mexican wolf, and there was no reason to believe they would hinder recovery. Illegal killing (“human predation”, considered factor (C) in the rule) was recognized as a factor that may slow, but not likely preclude, recovery in the Southwest. Regulatory protection of reintroduced Mexican wolves was deemed adequate (factor (D)). Finally, public attitudes toward gray wolves were cited as a primary determinant in the long-term recovery status of wolves (factor (E)), and the rule anticipated that the potential for human-wolf conflicts would increase as the number of wolves increased.

A current 5-factor analysis provides an opportunity to incorporate information available since the 2003 reclassification to assess threats to the Blue Range population.

(A) the present or threatened destruction, modification, or curtailment of its habitat or range;
Factor (A) considers whether habitat alteration threatens the species in either the present or future. Wolf habitat, at its most fundamental, can be defined by three ecological conditions – large area size, adequate prey, and security from human exploitation (Carbyn and Fritts, 1995, and see "Gray Wolf Biology and Ecology", above). While available information about current and ongoing habitat alteration related to these three conditions enables at least qualitative assessment of threats to the present Blue Range population, the degree to which habitat alteration may hinder future recovery must consider projections of future events and landscape trends in relation to updated recovery criteria. Such criteria should specify the abundance and distribution of wolves needed for recovery in relation to future modifications to the boundaries of the BRWRA/MWEPA. Lack of an up-to-date recovery plan containing such criteria, and lack of a determination of how the BRWRA/MWEPA may be modified, preclude such analyses (see "The Mexican Wolf Blue Range Reintroduction" and "Status and Implications of Gray Wolf Recovery in the Northern Rockies and Great Lakes for the Southwest"). However, results from simulations of future wolf habitat suitability will be briefly discussed for insight into development trends that may warrant attention as decisions affecting the future of the reintroduction and recovery effort are made.

The area requirements for wolf recovery efforts are large. Area requirements for the wolf have been estimated to be in the range of 10,000-13,000 km^2 (4,000-5,000 mi^2) if the area is isolated from other populations (Mech, in Henshaw 1979:430 and Soulé 1980:163). In contrast, Isle Royale National Park in Lake Superior has supported a population of 12-0 wolves for 50 years in an area of just 538 km^2 (210 mi^2) (Wayne et al. 1991). Following a review of pertinent literature and wolf population case histories, Fritts and Carbyn (1995) concluded that areas as small as 3,000 km^2 (1,158 mi^2), or even smaller, may be adequate to support a wolf population under near ideal circumstances (that is, abundant prey, a high level of tolerance for wolves by humans living in or using the area or adjacent areas, and effective legal protection); the wolf population that served as support for their conclusion ranged from 40-120 wolves over a 60 year period. Ideal conditions are rare, however, and estimated population requirements often require areas larger than available reserves (e.g., parks or designated wilderness areas) (Soule 1980:164). In such cases, it may be necessary to establish a network of habitat sites with interchange of wolves between areas to achieve an overall population target (Fritts and Carbyn 1995).

The BRWRA was selected for the reintroduction effort based on its size and abundance of native prey species, as well as its topography, water availability, Federal land status, human density, road density, and historic inhabitance by wolves (USFWS 1996:2-2 – 2-4). Since the designation of the BRWRA in 1998, the recovery area has remained constant in size, and thus continues to provide 17,775 km² (6,845 mi²) of ecologically suitable wolf habitat, 95 percent of which occurs on Forest Service lands (63 FR: 1752-1772). The 1982 Mexican Wolf Recovery Plan suggested that a population of 100 wolves could likely be supported in an area of 5,000 mi^2 (12,950 km^2) (USFWS 1982) and the FEIS found that the BRWRA was large enough to support the recovery plan's recommendation to establish a population of at least 100 wolves (USFWS 1996: 2-5). In 2000, WMAT agreed to allow wolves to inhabit FAIR, and in 2002 signed an agreement allowing direct release of wolves onto FAIR, providing an additional 6,475 km² (2,500 mi²) of wolf habitat. Thus, the BRWRA is within recognized estimates of appropriate size for its population target, has not changed in size since its designation in 1998, and the addition of FAIR lands for wolf establishment has resulted in an increase in the habitat available to support the BRWRA population.

Initial projections in the FEIS estimated that the BRWRA contained adequate prey to support a population of 100 wolves; prior to the reintroduction, a population of 15,800 elk (average density 3.7/km²), and 57,170 mule deer and white-tailed deer (average density 13.36/ km²) were estimated to be present in the BRWRA (USFWS 1996). The 3-Year Review hypothesized the BRWRA could support a range of 292-821 wolves, with elk in the BRWRA supporting about 213 wolves and combined deer species supporting about 255 wolves, based on agency estimates of elk and deer populations (Paquet et al. 2001: 47). This estimate was solely for the BRWRA and did not include the ability of FAIR to support wolves. Currently, AGFD, NMDGF, and WMAT collect data on prey abundance, but data are not available or comparable for the entire BRWRA, and AMOC has identified improved prey monitoring as one of the project's technical needs (AMOC and IFT 2005: ARC – 6). The limited available information does not suggest that the Blue Range population is food limited: 1) starvation and interspecific strife have not been documented in the Blue Range population, and only two cases of significant weight loss have been documented (AMOC and IFT 2005: TC-21); 2) no detectable changes in big game availability have occurred as a result of wolf reintroduction (AMOC and IFT: TC- 21); and, 3) there is no indication from annual project reports conducted since the 5-Year Review that prey availability is a limiting factor for the Blue Range population (USFWS 2006a; AGFD et al. 2007, AGFD et al. 2008). Thus, it seems likely that the BRWRA contains adequate prey to continue to support the reintroduced population.

Roads can be a significant form of habitat modification to wolves because roads: are known to be a source of wolf mortality due to vehicular collision; support residences and farms, the presence of which may lead to wolf-human or wolf-livestock conflicts that may be addressed with lethal management actions or permanent removal of a wolf; and may facilitate illegal take by people accessing wolf habitat from the road (Fritts et al. 2003). These are all forms of human exploitation that can affect the suitability of wolf habitat. (Wolf-related conflict management and illegal take are addressed under factors (D) and (E), below). It has been recommended that areas targeted for wolf recovery have low road density of not more than 1 mile of road per square mile of area, or 1.6 km of road per 2.56 square kilometers (Thiel 1985), although several studies in North America have documented that wolves initially absent from areas of high road density during colonization of an area later occupied areas with relatively high population and road density (Fritts et al. 2003). Road density in the BRWRA was estimated at 0.8 mi road/mi^2 (1.28 km road/km^2) area prior to the reintroduction (Johnson et al. 1992: 48). In the decade since the reintroduction has been underway, the Forest Service has not calculated road density in the Gila and Apache National Forests, and a formal comparison between prior and current road density in the BRWRA is not possible without that information. Roads in the BRWRA primarily exist to support forest management, livestock grazing, recreational access, and transport of forest products (USFWS 1996: 3-13).

Vehicular collision has been the second biggest source of mortality for wolves in the Blue Range population between 1998 and June 1, 2009 (12 out of 68 total documented Mexican wolf deaths) (USFWS 2009: Population Statistics). The number of annual vehicular-related deaths has been small, but relatively constant, ranging from zero to two per year, with the exception of a high of four vehicular-related wolf deaths in 2003 (USFWS 2009: Population Statistics). The number of vehicular-related mortalities has not shown a trend (increasing or decreasing) over time (USFWS 2009: Population Statistics).

Determining the degree of threat posed by vehicular collision to the population illustrates that loss of even a single animal from a small population can be disproportionately large; for example, 1 wolf death from vehicular collision in 1999 (minimum population count = 15 wolves) signified a 6 percent decrease in the population's size, whereas 1 wolf death in 2006 (minimum population count = 59 wolves) signified just over a 1 percent decrease in population size (USFWS 2009: Population Statistics). However, annual population decline due to vehicular mortality has never reached 10 percent, and in all but 2 years was below 4 percent (USFWS 2009: Population Statistics). We have no information on changes in road density (or traffic patterns, for which a baseline was not provided in the FEIS) in the BRWRA, nor for areas outside of the BRWRA through which wolves may try to disperse. Thus the annual number of mortalities from vehicle collision is relied upon in this document as an indication of the severity of this threat. As a qualitative generalization, vehicular collision is resulting in a low but steady source of mortality to the population. If the annual number of vehicular-related wolf mortalities remains within its current range, provided the population remains at its current size or greater, the threat to the Blue Range population from vehicular collision appears minimal. Vehicular collision has not been identified in previous project evaluations as a significant threat (e.g., Paquet et al. 2001, AMOC and IFT 2005).

Summary statement: Threats to habitat, defined by the three fundamental conditions of large area size, adequate prey, and insignificant levels of road-related wolf mortality (specifically, vehicular collision), do not likely threaten the Blue Range Population at the current time, given that the BRWRA has not changed in size since its designation in 1998, supplemental land has been provided by WMAT for wolf establishment adjacent to the BRWRA, there is no indication that wolves are food-limited by native prey abundance, and the number of vehicular-related wolf deaths has been small each year.

Habitat necessary for wolves in the future will entail the same ecological conditions as it does today, namely adequate prey, large areas, and security from excessive mortality (Fritts and Carbyn 1995). Several regional spatially-explicit population habitat viability analyses have been conducted in recent years to identify suitable gray wolf habitat in the Southwest, southern Rockies, and Mexico, and assess how suitability may change over time. Given that site-specific assessment of future habitat threats is precluded by lack of recovery criteria and potential modification to the BRWRA/MWEPA, consideration of these analyses can at least provide an indication of trends that may affect recovery.

According to Carroll et al. (2003, 2005, 2006), there are a number of adequately-sized, ecologically suitable blocks of habitat in the Southwest, southern Rockies, and Mexico for establishment of wolf populations. However, model simulations suggest that these sites are impacted in the future by human population growth and associated road development on public and private lands surrounding core wolf habitat (Carroll et al. 2003, Carroll et al. 2005, Carroll et al. 2006). For example, simulations of gray wolf establishment at sites in the Southwest (Utah, Colorado, Arizona, New Mexico, and Trans-Pecos Texas) and Mexico (Sonora, Chihuahua, Coahuila, Nuevo Leon, Durango, Tamaulipas, and portions of Zacatecas and San Luis Potosí) suggest that habitat that is currently suitable for reintroduction and persistence of gray wolf populations will be less able to support wolf populations in the year 2025 (Carroll et al. 2005). Development (i.e., roads) on public and private land resulted in a 25 percent decline in carrying capacity of the United States portion of the region by the year 2025, with private land development accounting for two-thirds of this decline. Extinction risk at individual reintroduction sites for current scenarios was generally low, but increased in future scenarios by as much as 20 percent. The increase in extinction risk was in part based on a metric used to estimate wolf mortality that captures the association between wolf mortality and proximity to roads and areas of high human density. (This metric captures a suite of human-caused mortality sources related to roads, e.g., vehicle collisions as well as poaching, therefore it is impossible to tease out effects solely from vehicle collision and simulation results are perhaps equally applicable to considerations of social tolerance and illegal killing, factor (E)). Simulations of New Mexico and Colorado reintroduction sites showed the greatest vulnerability to landscape development, as compared to larger core habitat blocks in Arizona. Connectivity between reintroduction sites in the United States also diminished substantially by 2025, leaving some sites relatively isolated (Carroll et al. 2005).

In addition to the trends of increasing human population growth and resultant development on public and private lands explored in these analyses, other potentially significant sources of habitat modification that may impact future recovery efforts in the region could include the United States-Mexico border fence or climatic factors, depending on the location of future reintroduction and recovery efforts.

Summary statement: Increasing human population and development over the next two decades may result in declining habitat suitability for wolves throughout the Southwest. As the BRWRA population expands toward the population objective of 100, if modification to the geographic boundaries and associated regulations of the BRWRA/MWEPA occurs, or if additional reintroduction sites are selected for wolf reestablishment, trends related to area size, prey availability, and road-related mortality may increase in importance.

One issue closely related to habitat curtailment warrants mention: the regulations associated with the internal and external boundaries of the BRWRA. This issue is discussed under factor (D), below, because it is viewed as a regulatory constraint placed on habitat that otherwise is of sufficient size and ecological condition to support the existing population.

(B) overutilization for commercial, recreational, scientific, or educational purposes;
Since the inception of the Mexican wolf reintroduction, the Service has not authorized legal killing or removal of wolves from the wild for commercial, recreational (i.e., hunting), scientific, or educational purposes. Illegal killing of wolves for their pelts is not known to occur in the Southwest, nor is illegal trafficking in wolf pelts or parts known to occur. Mexican wolf pelts and parts from wolves that die in captivity or in the wild are used for educational purposes, such as taxidermy mounts for display, when permission is granted from the Service; most wolf parts are sent to a curatorial facility at the University of New Mexico to be preserved, catalogued, and stored. A recreational season for wolf hunting is not currently authorized in the Southwest, and would only become so in conjunction with post-delisting monitoring and applicable state regulations. Several ongoing Mexican wolf research projects occur in the BRWRA or adjacent tribal lands by independent researchers or project personnel, but these studies have utilized radio-telemetry, scat analysis, and other non-invasive methods that do not entail direct handling of, or impact to, wolves. Non-lethal research for the purpose of conservation is also conducted on Mexican wolves in the SSP captive breeding program; current projects include research on reproduction, artificial insemination, and semen collection (USFWS 2006a).

Interagency Field Team and other agency personnel handle and confine wild wolves during the administration of vaccines and medical treatment, and during non-lethal control or capture actions in the field and captive pre-release facilities. These activities are not considered scientific in purpose, rather they are discretionary management activities that support implementation of the reintroduction project. Between 1998 and June 1, 2009, two capture-related wild wolf mortalities occurred (USFWS 2006a, USFWS 2001); one of these wolves was a permanent removal (USFWS 2006a), and one was a candidate for future re-release (USFWS 2001). Eight wild wolf mortalities have occurred in captive facilities that prevented these wolves from being candidates for re-release to the wild; two pups brought into a pre-release pen from the wild were exposed to parvovirus and died in captivity in 1999 (Siminski 2005), and six pups brought into a captive pre-release facility were killed by surrogate wolf parents in 2006 in an unsuccessful cross-fostering situation conducted in response to depredation events by the pups' biological parents that had triggered SOP 13 (see factor (D)) (USFWS 2006a). This is a small number of mortalities of wild wolves that could have been re-release candidates when considered over the span of the reintroduction, especially in the context of the hundreds of handling and capture events conducted over the course of the project and the importance of such activities to ensure disease prevention, enable monitoring, and respond to wolf-human or wolf-livestock conflicts.

Summary statement: Overutilization for commercial, recreational, scientific, or educational purposes is not considered a threat to the Mexican wolf because the Service does not authorize legal killing or removal of wolves from the wild for commercial, recreational (i.e., hunting), scientific, or educational purposes; illegal killing or trafficking for pelts is not known to occur; and non-lethal techniques are used during Mexican wolf research.

(C) disease or predation;
A number of viral, fungal, and bacterial diseases and endo- and ectoparasites have been

documented in gray wolf populations (Kreeger 2003). Typically, diseases are transmitted through direct contact (e.g., feces, urine, or saliva) with an infected animal, or by aerosol routes. Parasites are picked up through water, food sources, or direct contact; wolves are able to tolerate a number of parasites, such as tapeworms or ticks, but at times such organisms are lethal (Kreeger 2003).

There is little research specific to disease or contaminant issues in Mexican wolves, and little documentation of disease prevalence in wild wolves in the Blue Range population. Information from studies of other wild North American gray wolf populations is summarized in the threat analyses conducted for the delisting of the Great Lakes and Northern Rockies populations based on disease occurrences in those geographic regions, and can be referenced for a broader list of diseases than those described below (see 72 FR 6051-6103, February 8, 2007 and 73 FR 10513-10560, February 27, 2008). Contaminants that occur in the environment may have the potential to affect wolves through transfer in the food chain, but little data has been published on pollutant or pesticide levels in wolves (e.g., see Shore et al. 2001).

Mexican wolves are routinely vaccinated for rabies, distemper, parvovirus, and corona virus before release to the BRWRA from captive facilities (USFWS 2006a). Wolves that are captured in the wild are vaccinated for the same suite of diseases. The following descriptions of these diseases have been summarized based on Kreeger (2003) unless otherwise noted.

Rabies, caused by a rhabdovirus, is an infectious disease of the central nervous system typically transmitted by the bite of an infected animal. Fox variants of rabies have been the primary vectors when the disease is reported in wolves. An animal infected by rabies may exhibit a variety of symptoms as it proceeds through several stages of the disease; the animal may experience paralysis of the throat and excessive salivation, advancing to a state of agitation in which the animal may bite at inanimate objects, people, or other animals, to an advanced paralysis that leads to death. Rabies can spread between infected wolves in a population (e.g., among and between packs), or between populations, resulting in severe population declines. Once an animal exhibits symptoms of the disease, it is untreatable.

A rabies outbreak in and near the BRWRA began in 2006 in eastern Arizona and continues through 2009, with positive rabies diagnoses (fox variant) in both foxes and bobcats. No wolves in the Blue Range population were diagnosed with rabies during this outbreak (AZDHS 2008: Rabies Statistics and Maps) or throughout the history of the reintroduction (USFWS 2009: Population Statistics).

Canine distemper, caused by a paramyxovirus, is a febrile disease typically transmitted by aerosol routes or direct contact with urine, feces, and nasal exudates. Symptoms of distemper may include fever, loss of appetite, loss of coordination (ataxia), shortness of breath (dyspnea), swollen feet, and eye and nose discharge. Death from distemper is usually caused by neurological complications (e.g., paralysis, seizures). Once an animal is infected, distemper is untreatable. Although wolf populations are known to be exposed to the virus in the wild, mortality from distemper in wild wolves is uncommon.

Two Mexican wolf pups brought to a wolf management facility in 2000 from the wild were diagnosed with distemper, indicating they were exposed to the disease in the wild, and died in captivity (AMOC and IFT: TC-12). These are the only known mortalities due to distemper documented in relation to the Blue Range population, and are considered captive deaths rather than wild mortalities (USFWS 2009: Population Statistics).

Canine parvovirus is an infectious disease caused by a virus that results in severe gastrointestinal and myocardial (heart disease) symptoms. Canine parvovirus can be transmitted between canids (e.g., wolves, coyotes, dogs), but not to other hosts such as humans or cats (although there are other strains of parvovirus that can infect both). Canine parvovirus is typically transmitted through contact with feces or vomit, where it can survive for months. Symptoms of an infected adult animal may include severe vomiting and diarrhea, resulting in death due to dehydration or electrolyte imbalance. Pups may die from myocardial (heart) disease if infected with canine parvovirus while in utero or soon after birth from cardiac arrhythmias. Although canine parvovirus has been documented in wild wolf populations, there are few documented mortalities due to parvovirus; it is hypothesized that parvovirus is a survivable disease, although less so in pups. Parvovirus may have been a contributing factor to high levels of pup mortality in Yellowstone National Park during several summers (Smith and Almberg 2007) and is thought to have slowed various stages of colonization and dispersal of wolves in the greater Minnesota population (Mech et al. 2008). Captive wolves have been successfully treated with fluid therapy until symptoms abated.

Three Mexican wolf pups brought to wolf management facilities from the wild died from canine parvovirus in 1999, indicating that at least one of them had been exposed to the disease in the wild (AMOC and IFT 2005: TC-12). Mortality from canine parvovirus has otherwise not been documented in the Blue Range population (USFWS 2009: Population Statistics). (Note: one pup died in the pen in the wild and is the single disease-related mortality documented for the wild population, the other two pups died at a pre-release captive facility and are considered captive mortalities.)

Corona virus is an infectious disease transmitted primarily through feces (Zarnke et. al. 2001). Symptoms in canids (dogs, wolves, coyotes) include diarrhea and dehydration. Infection of dogs and coyotes by both corona virus and canine parvovirus has been documented, resulting in symptoms similar to canine parvovirus but more severe (Zarnke et al. 2001). Mortality due to corona virus has not been documented in the Blue Range population (USFWS 2008: Population Statistics).

Monitoring of collared wolves in the Blue Range population has not documented significant levels of wolf mortality due to disease. Of 68 total documented wolf deaths between 1998 and June 1, 2009, 1 death has been attributed to disease (canine parvovirus) (USFWS 2009: Population Statistics). Neither the 5-Year Review nor annual reports in the following years indicate that disease is a concern or is significantly impacting population growth rate (USFWS 2006a, AGFD et al. 2007, AGFD et al. 2008). However, some diseases are more likely to spread as wolf-to-wolf contact increases (Kreeger 2003), thus the potential for disease outbreaks may increase as the population expands in numbers or density. Therefore, the potential remains for disease to threaten the population in the future. In addition, potential pup mortality caused by disease may be poorly documented in the free-ranging population because these pups are too young to radio collar.

Summary statement: Disease is not considered a threat to the Mexican wolf at the current time based on known occurrences in the Blue Range population and the active vaccination program.

In addition to disease, factor (C) also requires consideration of threats due to predation. Wild predators do not regularly prey on wolves (Ballard et al. 2003). Although large prey may occasionally kill wolves during self-defense (Mech and Peterson 2003), this is rare and not considered predation on the wolf. Between 1998 and June 1, 2009, three documented Mexican wolf mortalities were due to predators (USFWS 2009: Population Statistics, USFWS 2006a, AGFD et al. 2007). Monitoring of Northern Rockies wolf populations demonstrated that wolf-to-wolf conflicts may be the biggest source of predation among gray wolves, but this typically occurs from territorial conflicts and has not occurred at a level sufficient to affect these populations' viability (73 FR 10513-10560, February 27, 2008). As the Mexican wolf population begins to saturate available habitat, wolf mortalities resulting from territorial conflicts may become more prevalent. However, information does not indicate that wolf-to-wolf or other sources of predation are a threat to the current or future Mexican wolf recovery effort.

Intentional human-caused mortality of wolves has sometimes been considered "human predation" by the Service and assessed under factor (C), but this assessment places intentional human-caused mortality under factor (E).

Summary statement: Predation is not considered a threat to the Mexican wolf because no wild predator regularly preys on wolves and only a small number of predator-related wolf mortalities have been documented in the Blue Range population.

(D) the inadequacy of existing regulatory mechanisms;
A number of concerns have been raised regarding the adequacy of regulatory mechanisms being applied to the Mexican wolf recovery program and reintroduction project pursuant to the ESA. To some degree, this may be expected during the implementation of a complex program such as wolf recovery, indicating differing levels of social tolerance for wolves or that there are several methods for achieving objectives, with pros and cons inherent in each. For example, wolf recovery may be pursued by designating wolves as endangered across their entire range, or by offering the flexibility inherent in the designation of non-essential experimental populations in certain locations. As time passes, the adequacy of the regulatory mechanisms being applied becomes apparent.

The adequacy, or appropriate implementation of the following regulatory (i.e., stipulated by the Final Rule or the ESA) or management (i.e., discretionary actions implemented by the Service) mechanisms have been raised in the 3-Year Review, 5-Year Review, annual project reports, or active litigation: 1) the internal and external boundaries of the BRWRA, including the configuration of the Primary and Secondary Recovery Zones and the regulations governing removal of wolves due to boundary violations; 2) regulations or management procedures for livestock management (e.g., carcass removal); 3) management procedures related to livestock depredation (SOP 13); 4) implementation of conservation actions by Federal agencies pursuant to section 7(a)(1) of the ESA; 5) the alleged transfer of management authority of the reintroduction project from the Service to AMOC; and, 6) revision of the 1982 Mexican Wolf Recovery Plan.

The efficacy of the configuration of the internal and external boundaries of the BRWRA has been critically assessed in both the 3-Year and 5-Year reviews. Paquet et al. (2001:61) stated that the small size of the Primary Recovery Zone (the Apache National Forest, the zone designated for release of wolves) was hindering rapid establishment of the wild population and recommended that the Final Rule be modified to allow releases in the Secondary Recovery Zone (the Gila National Forest and portions of the Apache National Forest). AMOC concluded in the 5-Year Review that the provision governing release of wolves solely into the Primary Recovery Zone restricts the pool of available release candidates, restricts release of wolves for management purposes such as genetic augmentation, and causes public perception issues between the states of Arizona and New Mexico, and thus is not sufficient to achieve the current population objective (AMOC and IFT 2005: AC-14-15). Since the 5-Year Review, initial releases were conducted in 2004 (five wolves), 2006 (four wolves), and 2008 (one wolf). No discussion is offered in the IFT annual reports from 2004-2008 as to whether these initial releases were sufficient or whether additional releases were hindered due to the regulations associated with the Primary Recovery Zone (AGFD et al. 2004, AGFD et al. 2005, AGFD et al. 2006, AGFD et al. 2007, AGFD et al. 2008)

In the 3-Year Review, Paquet et al. (2003: 23, 65) also noted that wolves were dispersing outside of the external boundaries of the BRWRA into the MWEPA and would continue to do so, given the long-distance movements of normal wolf activity. They concluded that the provision in the Final Rule requiring removal of wolves that establish territories wholly outside of the BRWRA boundaries was contrary to normal wolf movement patterns and recommended that the Final Rule be modified to allow wolves to establish territories outside of the BRWRA. In the 5-Year Review, AMOC concluded, based on several additional years of project implementation since the 3-Year Review, that boundary removals were hindering natural dispersal and colonization, creating unrealistic public expectations that wolves could be successfully captured when they left the BRWRA, and creating staffing and logistical concerns related to the effort required to attempt such removals (AMOC and IFT 2005: AC-18). Calculations in the 5-Year Review demonstrated that a hypothetical wolf dispersing the average lone-movement distance (i.e., 87 km) in a random direction from the center of the BRWRA and FAIR would end up outside the BRWRA 66 percent of the time, and indeed project data was showing that the majority of single dispersers were ending up outside of the BRWRA (AMOC and IFT: TC-20). AMOC recommended that the Final Rule be modified to allow wolves to expand into the MWEPA in order to reduce removals associated with boundary violations (AMOC and IFT 2005: TC-24) and committed to further analysis of the extent to which boundaries should be modified (AMOC and IFT 2005: ARC-3).

Between 1998 and December, 2008, removal of wolves from the wild for boundary violations has been the second leading cause of management removal in the BRWRA (41 boundary removals out of 144 total removals, or 28 percent) (USFWS 2009: Population

Statistics). Between 2005 and 2008, boundary violations accounted for approximately 20 percent of removals (17 percent or 25 percent depending on whether pups are included in removal statistics) (USFWS 2009: Population Statistics), indicating that boundary violations are continuing to occur regularly. Since the 5-Year Review, AMOC has continued to identify the consistently high removal rate as one of the primary factors hindering the progress of the reintroduction (AGFD et al. 2007) (see discussion of SOP 13, below, and discussion of cumulative effects under factor (E) for additional data concerning the impact of the high removal rate on the population).

In response to analysis in the 3-Year and 5-Year Reviews demonstrating that the internal and external boundaries of the BRWRA are not fully supporting the reintroduction objective, the Service has initiated, or indicated intent to initiate, modification of the Final Rule two times. Initial progress toward revising the Final Rule between 2001 and 2003 was eclipsed by the Service's subsequent intent to revise the 1982 Mexican Wolf Recovery Plan to provide big picture guidance for the recovery program before proceeding with revision to the reintroduction project. AMOC resumed consideration of boundary modifications after the Service put the recovery team on hold in 2005, and rule modification is now underway for a second time (AMOC and IFT 2005: AC-14-19) (USFWS 2009: Rule Modification). However, revision of the internal and external BRWRA boundaries has not yet occurred.

Summary statement: The 3-Year and 5-Year Reviews have unequivocally stated that the internal and external boundaries of the BRWRA are hindering establishment and growth of the population toward the population target of at least 100 wolves. Data collected following the 5-Year Review continues to demonstrate that boundary-related removals are a significant percentage of total removals and that the high removal rate is hindering the population's growth.

Summary statement: The Service has indicated intent to modify the Final Rule, in part to address the internal and external boundaries of the BRWRA, but modification has not yet occurred.

During the planning of the reintroduction project, the amount of permitted public lands grazing in the BRWRA was identified as a likely source of conflict for the reintroduction due to the potential for wolf depredation of livestock and related social and economic issues (USFWS 1996: 2-4). In the 3-Year Review, Paquet et al. (2001: 52-54) concluded that livestock depredation by wolves was occurring and that wolf-livestock interaction would continue due to the spatial and temporal occurrence of livestock in the recovery area. They stated that sufficient information was not provided for a detailed analysis of the adequacy of the depredation control program. They followed this with a recommendation that implementation of specific livestock husbandry techniques, particularly removal of carcasses, could lessen the potential of wolves becoming habituated and subsequently depredating livestock and therefore should be required for livestock operators on public lands (p. 67).

From a strictly biological perspective of the project (i.e., growth of the wolf population to achieve the population target), the issue of depredation predisposition is important because wolves that are involved in depredation incidents are subject to potential management action (see discussion of SOP 13, below). Two recent studies of factors affecting wolf depredation of cattle in the Northern Rockies and the Great Lakes provide inconclusive results as to whether wolves display a depredation predisposition (Mech et al. 2000, Bradley and Pletscher 2005), leaving the issue scientifically unresolved. In the 5-Year Review, AMOC analyzed available data to determine the extent to which a carcass feeding issue exists. They concluded that the number of depredations committed after wolves were known to have fed on a carcass was too small of a sample size to determine whether a "depredation predisposition" exists (AMOC and IFT 2005: AC-31). However, it cannot be assumed that those events recorded were the only ones that occurred, given the difficulty in knowing about and locating a carcass in open rangeland and in detecting scavenging or predation events with the current frequency of monitoring.

AMOC also investigated Federal and State authority to regulate carcass removal and related husbandry practices and determined that Federal agencies (Forest Service and Bureau of Land Management) do not have authority pursuant to federal statute to require lease and permit holders to remove carcasses from public land as a "special term and condition" of the permit, although they can encourage landowners to dispose of carcasses. These Federal agencies are further constrained in requiring disposal of carcasses because the States have jurisdiction over the possession of livestock and enforcement issues. AMOC committed to development of a conceptual incentives program to address this and related wolf nuisance and depredation issues (AMOC and IFT 2005: AC-30 – 32).

The Service has recently established a non-regulatory Mexican Wolf Interdiction Program to address wolf-livestock issues, administered through the National Fish and Wildlife Foundation. The goal of the program is to prevent or mitigate wolf depredation and nuisance impacts on local stakeholders through voluntary interdiction, incentive, and compensation programs. Guidelines for the program to be established based on a consensus of participating ranchers, sportspeople, environmental interest group representatives, and local community members, with oversight by the Fish and Wildlife Service. In addition to providing funds for livestock losses due to wolf depredations, the Interdiction Program will support proactive on-the-ground practices that reduce the potential for depredations, thus simultaneously supporting landscape conservation and improved land use practices in the Southwest.

Summary statement: Data analysis is inconclusive as to whether Mexican wolves display a depredation predisposition. No connection has been made between this specific depredation issue and the rate of growth of the Blue Range population, e.g., that depredation incidents resulting in permanent removal of wolves are largely due to wolves' habituation to carcasses. Regulatory mechanisms are not available to require carcass removal on public grazing lands.

Summary statement: The Service has recently established a non-regulatory Mexican Wolf Interdiction Program in collaboration with the National Fish and Wildlife Foundation to help resolve wolf-livestock issues at the local level.

A second facet of conflict that has arisen between wolves and livestock in the BRWRA relates to discretionary management response to depredation events. AMOC developed SOP 13 in 2005 to specify criteria for determining the status of depredating and non-depredating wolves and provide guidelines for conducting control actions in response to depredation events (USFWS 2009: Blue Range Reintroduction Project – Standard Operating Procedures). In particular, SOP 13 requires the removal of wolves involved in three depredation incidents in a 365-day period. Between 1998 and December, 2008, wolf-livestock conflict was the leading cause of management removal of wolves in the Blue Range population (70 livestock-related wolf removals out of 144 total removals, compared to 41 removals for the second-ranking cause, boundary violation). Removals in 2006 and 2007, during which time SOP 13 was actively implemented, had the highest number of removals of all years (16 and 19 removals, respectively) (USFWS 2009: Population Statistics). At the end of 2007, the lead agencies acknowledged that the aggressive removal rate of wolves by management due to depredation, nuisance, and boundary issues was hindering population growth, although they also reiterated the importance of demonstrating a high level of responsiveness to conflicts (AGFD et al. 2007). One wolf was involved in 3 or more depredation incidents in a 365-day period during 2008. However, trapping efforts to capture this animal were unsuccessful during the time period of the removal order and thus no permanent removals were conducted pursuant to SOP 13 in 2008 (AGFD et al. 2008). An explanation for this drastic difference is not provided in the IFT's 2008 annual report, for example, that wolves had not recolonized areas close to livestock where permanent removals occurred in 2006 and 2007, or that proactive management decreased repeat depredation events. Therefore, what can be concluded is that in two years SOP 13 had significant negative effect on the growth of the Blue Range population, and in one year it had no effect. A Clarification Memo to SOP 13 was approved in May, 2009, that incorporates consideration of the biological progress of the population when reaching a decision regarding management response for a wolf or wolves under review. In response to two lawsuits challenging the Service's adoption and implementation of SOP 13 (<u>Defenders of Wildlife et al. v. Tuggle et al.</u>, Civil No. 4:08-cv-280-DCB (D. Ariz.) and <u>WildEarth Guardians et al. v. USFWS et al.</u>, Civil No. 2:08-cv-820-DCB (D. Ariz.)), the Service issued a memorandum stating that it would not make any further decisions that relate to the Mexican Wolf Recovery Program pursuant to SOP 13 as issued on April 30, 2005, or as altered by the Clarification Memo on May 28, 2009.

Summary statement: The number of wolf removals due to livestock depredation has been substantially higher than removals for any other reason. The high number of wolf removals (depredation, nuisance, and boundary violation) has been identified as a contributing factor hindering the population's growth. SOP 13, a discretionary management action, resulted in the two highest years of removals since the beginning of the project, as well as a year with no depredation-related removals. In response to two lawsuits challenging the adoption and implementation of SOP 13, the Service issued a memorandum stating that it would not make any further decisions pursuant to SOP 13.

The two lawsuits on SOP 13 also challenge the adequacy of regulatory mechanisms for the Mexican wolf on two other counts. The <u>WildEarth Guardians et al. v. USFWS et al.</u> lawsuit alleges the failure of the Forest Service to develop and carry out a program for the conservation of the Mexican wolf pursuant to section 7(a)(1) of the ESA, while the <u>Defenders of Wildlife et al. v. Tuggle et al.</u> lawsuit alleges the Service has delegated authority to AMOC for the reintroduction project through the MOU (see "The Mexican Wolf Blue Range Reintroduction") in violation of both the ESA and the APA. The Forest Service currently conducts a number of activities pursuant to 7(a)(1), such as providing educational

information on the Mexican wolf recovery program on the Apache-Sitgreaves and Gila National Forests, constructing temporary holding pens and conducting related compliance and permitting, assisting with initial releases and translocations of wolves, meeting with livestock permittees to address wolf-related issues, and providing assistance in reducing livestock losses and wolf-livestock interactions. On December 3, 2009, the Defenders of Wildlife lawsuit was dismissed after the court entered a Consent Decree in which the Service recognized that the AMOC does not oversee the actions of the Service and that the AMOC has no decision-making authority over the Service with regard to the Service's management of the Mexican Wolf Recovery Program or the Mexican Wolf Reintroduction Project. A ruling has not been made in the WildEarth Guardians litigation.
Summary statement: Determination of the adequacy of the Forest Service's 7(a)(1) activities pursuant to the ESA for the Mexican wolf has yet to be resolved by current litigation. With regard to management structure, the Service has stated that the AMOC does not oversee the actions of the Service and that the AMOC has no decision-making authority over the Service with regard to the Service's management of the Mexican Wolf Recovery Program or the Mexican Wolf Reintroduction Project.

Last, both the 3-Year and 5-Year reviews reiterate that the 1982 Mexican Wolf Recovery Plan fails to provide current guidance to the reintroduction, particularly regarding establishment of objective and measurable recovery criteria, and recommend that a revised plan be developed (Paquet et al. 2001:64, AMOC and IFT 2005: AC-13). There is no indication that lack of an up-to-date recovery plan directly hinders the progress of the reintroduction toward its population objective of at least 100 wolves. However, in addition to the importance of establishing recovery criteria, an updated recovery plan would also contain prioritized actions to promote progress toward recovery. A revised recovery plan has still not been finalized (see "Status and Implications of Gray Wolf Recovery in the Northern Rockies and Great Lakes for the Southwest", as well as AMOC and IFT 2005: AC-10).

Summary statement: An up-to-date recovery plan is a fundamental component of an effective recovery program. The Service has not finalized an up-to-date recovery plan to provide an over-arching strategy, including recovery criteria and prioritized management actions, to guide wolf reintroduction and recovery in the Southwest.

Reintroduction and recovery programs can be, by their very nature, management-intensive and subject to trial and error. While several mechanisms have previously, and again herein, been identified as inadequate to fully support the growth of the Mexican wolf population toward its population target, the concerns (including those being resolved through litigation) are aimed at the application, interpretation, and implementation of available mechanisms by the Service and its interagency partners rather than the adequacy of the mechanisms themselves. That is, it is not the ESA's 10(j) provision, but rather specific characteristics of the BRWRA that hinder population growth; it is not the concept of wolf removal as a management tool in response to livestock conflict, but rather the rigid approach of SOP 13 that did not allow for consideration of the biological condition of the population to be incorporated in removal decisions; it is not the inadequacy of the statutorily required elements of a recovery plan, but that an up-to-date plan has not been developed. The Service and the lead agencies have taken steps to address some of the identified management and regulatory inadequacies; specifically, their efforts include the quarterly meetings of the Adaptive Management Working Group, which includes AMOC and other State and County governments, to gather input and address issues of concern (AGFD 2008; a series of public meetings held in November and December, 2007, to consider modifications to the Final Rule (72 FR 44065-44069, August 7, 2007; and see USFWS 2009: Rule Modification); multiple attempted revisions of the 1982 Mexican Wolf Recovery Plan; and the development of a Mexican-wolf-specific incentives program and application of existing incentives available through State and non-governmental programs to address socioeconomic issues related to wolf conflicts. In spite of these efforts, the Service is still resolving identified regulatory and management mechanisms related to the biological progress of the Blue Range population.

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

Public opinion has long been recognized as a significant factor in the success of gray wolf recovery efforts. Considerable literature exists on this topic, e.g., see Primm and Clark 1996, Boitani 2003, Fritts et al. 2003, Rodriquez et al. 2003, Bangs et al. 2004. In the Southwest, extremes of public opinion vary between those who strongly support or object to the recovery effort. Support stems from such feelings as an appreciation of the wolf as an important part of nature and an interest in endangered species restoration, while opposition may stem from negative social or economic consequences of wolf reintroduction, general fear and dislike of wolves, or Federal land-use conflicts (Duda and Young 1995, Unsworth et al. 2005, Research and Polling 2008). Thirty-one illegal shootings of wild Mexican wolves between 1998 and June 1, 2009, (USFWS 2009: Population Statistics) demonstrate some degree of disregard for or dissention to the reintroduction project, but is an unreliable indicator of public opinion overall. Recent public polling in Arizona and New Mexico shows that the majority of respondents has positive feelings about wolves and supports the reintroduction of the Mexican wolf to public land (Research and Polling 2008). Thus, for the time being it appears that public opinion is adequate to continue to support implementation of the Mexican wolf reintroduction.

Summary statement: Although some residents currently do not support the reintroduction of the Mexican wolf to the wild, the majority of the public in Arizona and New Mexico does support the reintroduction. Therefore, public opinion is not considered a threat to the Blue Range population.

In the BRWRA, illegal shooting of wolves has been the biggest overall source of mortality since the reintroduction began in 1998, and the largest single source of mortality in six separate years. Out of 68 wild wolf mortalities documented over the course of the reintroduction, 31 deaths are attributed to illegal shooting (USFWS 2009: Population Statistics). Illegal shootings have ranged from zero to seven per year between 1998 and June 1, 2009, with one or more shootings occurring every year with the exception of 1999 (USFWS 2009: Population Statistics). Reasons for such shootings are typically unknown, but are likely attributed to dislike of wolves or mistaken identity of Mexican wolves as coyotes. Law enforcement investigates all illegal shootings.

As discussed under factor (A), the significance of a given level of mortality is relative to the size of the population (and its growth rate, see discussion of cumulative effects, below). In several years (e.g., 1998, 2001, 2003, 2005), mortality due to illegal shooting resulted in substantial population declines of near or more than 10 percent. As with vehicular collision, illegal shooting is a constant source of mortality for the population. As compared with the small number of annual vehicular mortalities, however, illegal shooting has occurred at significant levels in multiple years, with almost three times as many total illegal shootings (n=31) occurring as vehicular collisions (n=12) over the course of the program. The effect of these mortalities on the population's trajectory has likely been moderated by the large number of wolves released between 1999 and 2005 (74 wolves) (USFWS 2009: Population Statistics).

Summary statement: Illegal shooting is the largest source of (human-caused) mortality to the Blue Range population, resulting in population declines of 10 percent or more in several years between 1998 and June 1, 2009.

Hybridization between wolves and other canids can pose a significant challenge to recovery programs (e.g., the red wolf recovery program) (USFWS 2007). In the Blue Range population, two hybridization events between Mexican wolves and dogs have been documented over the span of the reintroduction. In both cases, hybrid litters were humanely euthanized (AGFD and USFWS 2002, AGFD et al. 2005). No hybridization events between Mexican wolves and coyotes have been documented. Based on the number of occurrences of hybridization events, this is not considered a threat to the Blue Range population.

Summary statement: Two hybridization events between Mexican wolves and dogs, and no hybridization events between wolves and coyotes, have been documented in the Blue Range population. Based on this data, hybridization is not considered a threat to the Blue Range population.

The potential for inbreeding to negatively impact the captive and reintroduced Mexican wolf populations has been a topic of concern for over a decade (Parsons 1996, Hedrick et al. 1997). Inbreeding depression may affect traits that reduce population viability, such as reproduction (Fredrickson et al. 2007), survival (Allendorf and Ryman 2002), or disease resistance (Hedrick et al. 2003). For animals such as the Mexican wolf for which complete pedigree information is available, the relationship between the degree of inbreeding and specific fitness traits can be analyzed to determine the severity of inbreeding (Asa et al. 2007, Fredrickson et al. 2007).

Concern over the possibility of inbreeding depression (the reduction in fitness associated with inbreeding) in the captive population was one factor that led to the merging of the three founding lineages (McBride, Ghost Ranch, and Aragon) beginning in 1995 following confirmation of the taxonomic standing of the Ghost Ranch and Aragon lineages. At the time, experts advised that combining the lineages would increase genetic variation, the number of founders, and produce outbred (F1) wolves that should be free of any deleterious effects of inbreeding (Hedrick et al. 1997). Representation of genes from the McBride lineage of wolves, which had been managed the longest under the SSP and were thought to be less heavily inbred than Ghost Ranch and Aragon wolves, was set at 80 percent for the merged captive population, with the remaining 20 percent being split evenly between the Ghost Ranch and Aragon lineages. Assuming positive results of merging the lineages became apparent, an increase to 25 percent representation for both the Ghost Range and Aragon lineages was recommended for the captive population (Hedrick et al. 1997).

Several studies have been conducted to determine whether inbreeding depression exists and/or is resulting in decreased fitness in the captive and reintroduced populations of Mexican wolves. Initial study of the captive population found weak evidence of inbreeding depression on juvenile viability and litter size (Kalinowski et al. 1999), but subsequent research documented inbreeding depression affecting body size (Fredrickson and Hedrick 2002). More recently, it has been found that inbreeding appeared to have little or no effect on captive wolves from the founding lineages based on the probability of producing live pups, litter size, and pup survival. However, crosses between F1 wolves (the offspring of crosses between wolves of different lineages) produced 3.2 times more pups on average than contemporary crosses between pure McBride lineage wolves, demonstrating the low reproductive fitness of the McBride lineage wolves and the restored fitness of F1 wolves (Fredrickson et al. 2007). This restoration of fitness has been termed “genetic rescue” and results from the masking of recessive deleterious alleles that had become homozygous in the founding lineages as a result of inbreeding and genetic drift. Strong inbreeding depression, however, was observed for these traits among the descendents of F1 wolves (cross-lineage wolves). This resulted from the re-expression of recessive deleterious alleles as inbreeding began to reaccumulate in these wolves (Fredrickson et al. 2007). Additional research has suggested that lack of mating success in male wolves in the captive population may be explained by inbreeding depression on sperm quality in pure-lineage Mexican wolves (Asa et al. 2007).

Genetic management of the captive population is the primary focus of the AZA Mexican Wolf SSP, in support of their purpose to produce healthy wolves for reintroduction. In the captive population, wolf pairings are annually selected according to genetic, demographic and other biological criteria in order to slow the loss of genetic variation over time and to minimize inbreeding in the population (Siminski and Spevak 2008). The two primary strategies for slowing the loss of gene diversity in the captive population are increasing the representation of the Ghost Ranch and Aragon lineages above 10 percent each (currently 17.23 percent and 15.55 percent, respectively (Siminski and Spevak 2008)) and adding additional breeding facilities to increase the carrying capacity of the captive population (Siminski and Spevak 2008). Although slowing the loss of genetic variation and avoiding inbreeding continue to be a concern in the captive population, the AZA Mexican Wolf SSP has not identified inbreeding as a current threat to the captive program.

Coordination between the AZA Mexican Wolf SSP and the Service and the IFT to select wolves for release into the BRWRA that will establish the genetic representation of the three lineages in the reintroduced population occurs annually (e.g., see AGFD et al. 2007). The ratio of 80-10-10 ancestry of McBride, Aragon, and Ghost Ranch wolves originally established for the captive population has also been applied to the Blue Range population (Siminski and Spevak 2007). In the reintroduced population, genetic research has recently documented that inbreeding depression has resulted in smaller litter sizes in packs producing pure McBride pups compared to those producing cross-lineage pups, demonstrating restored fitness in wolves with mixed ancestry (Fredrickson et al. 2007). Based on the immediate fitness concerns related to inbreeding depression documented in the Blue Range population, as well as in support of maintaining the long-term adaptive potential of the Mexican wolf, it has been recommended that Ghost Ranch and Aragon ancestry be increased above 10 percent to as much as 25 percent by releasing more wolves with Ghost Ranch and Aragon ancestry to the Blue Range population while the population is still small, as the addition of just a few wolves into a small population will more significantly alter the ancestry represented than would those few releases into a large population (Fredrickson et al. 2007). The representation of the three lineages as of July 25, 2008, was 77.39 percent McBride, 8.43 percent Aragon, and 14.19 percent Ghost Ranch (Siminski and Spevak 2007). Rapid expansion of the population after these releases would further promote maintenance of genetic diversity (Fredrickson et al. 2007). Thus, documentation of the effect of inbreeding depression on litter size demonstrates that inbreeding has the potential to threaten, or at least hinder, the Blue Range population by negatively affecting the growth rate of the population. That is, the release of cross-lineage wolves has the potential to increase the fitness, growth rate, and genetic variation of the Blue Range population (Fredrickson et al. 2007). Results from the captive population, however, suggest that the fitness increase observed among F1 wolves may be largely lost in two to four generations.

The ability of management to address inbreeding depression in the Blue Range population is constrained by regulatory and discretionary management mechanisms that do not incorporate consideration of genetic issues yet result in limitation or alteration of the genetic diversity of the population. For example, initial releases of cross-lineage wolves may be constrained by lack of space (i.e., unoccupied territories) in the Primary Recovery Zone, and the high removal rate of wolves due to boundary violations results in an ever-changing degree of representation of the three lineages. The AZA Mexican Wolf SSP has recommended that until the representation of the Ghost Ranch and Aragon lineages has increased and demographic stability is achieved in the wild population, careful consideration of genetic diversity should be prioritized during decisions to permanently remove wolves (AZA 2008a). The Service has not developed any specific protocols to promote genetic fitness in the population in response to recent research and professional recommendations. However, it has recognized the importance of genetic considerations into management actions.

Summary statement: Inbreeding depression has recently been documented in the captive and reintroduced Mexican wolf populations. Inbreeding is not a current threat to the captive population based on active management that minimizes the risk of inbreeding depression, but has the potential to decrease the fitness, growth rate, and genetic variation of the Blue Range population unless addressed by appropriate management actions.

The assessment has not identified any individual threat that is so severe as to put the population at immediate risk of failure, although several management and regulatory mechanisms, illegal shooting, and inbreeding are identified as threats that are hindering the growth, fitness, and long-term success of the Blue Range population. But the population does not experience a single threat in absence of the others; rather all threats occur simultaneously or at least within spatial or temporal proximity to one another. Therefore, it is necessary to consider the cumulative effect of the negative forces acting on the population to fully understand its status.

The degree to which a wolf population is able to withstand a given level of mortality depends on the population's productivity, including factors such as the level of reproduction, and whether breeding animals are killed (Ballard et al. 1987, Fuller 1989, Ballard et al. 1997, Fuller et al. 2003, Brainerd et al. 2008). The loss of any animal, particularly a breeding adult, is important when a population is small in size and has a limited number of breeding adults. That is, mortality not only reduces the size of the population, but can also reduce the population's ability to recover. As a rule of thumb, an overall mortality rate of 0.34 (34 percent) has been estimated as the inflection point for wolf populations, with populations increasing naturally when mortality rates are below this average and decreasing when mortality rates are above it (Fuller et al. 2003). In the Blue Range population, the loss rate (all sources of mortality and missing wolves) was estimated at 25 percent between 1998-2003, consistent with predictions from the FEIS and substantially less than that of other documented gray wolf populations in North America (AMOC and IFT 2005: TC-13, 19). During this time the population was demonstrating annual positive growth, although the large number of initial releases conducted influenced population growth and mediated the impact of the mortalities on the population (USFWS 2009: Population Statistics).

Combining multiple sources of mortality demonstrates the potential for cumulative effects to impact the Blue Range population. Two sources of human-caused mortality (vehicular collision and illegal shooting) are responsible for the majority – 43 of 68 – of Blue Range population deaths between 1998 and June 1, 2009 (USFWS 2009: Population Statistics). In nine years during this timeframe, these two sources of mortality outnumbered mortality from all other sources combined, and in two years resulted in a decreasing or stable population trend in a year that otherwise would have seen a population increase (i.e., 2003, 2008) (USFWS 2009: Population Statistics). Moreover, while both vehicular collision and illegal shooting have individually functioned as constant, low-level drains on the population punctuated by several years in which one or the other substantially reduced population size, cumulatively they resulted in population declines of 12 percent or greater in 5 years (USFWS 2009: Population Statistics).

Further demonstration of the importance of cumulative effects comes from the combination of human-caused wolf mortality observed in the BRWRA with removal of wolves for management purposes (e.g., boundary issues, cattle depredation, human nuisance, relocation, or pairing with another wolf), as these removals have the same practical effect on the wolf population as mortality if the wolf is permanently removed (as opposed to translocated) -- that is, the population has one less wolf (see Paquet et al. 2001). Removal rates in the Blue Range population have been higher than projected in the FEIS, as have combined mortality/removal rates; from 1998-2003 the combined mortality/removal rate was 64 percent, as compared to a projection of 47 percent (AMOC and IFT 2005: 12-13). The failure rate of the population (combined mortality and removal rate) has remained at high levels since 2003, documented as 0.47 in 2007 (AGFD et al. 2007) and 0.40 in 2008 (AGFD et al. 2008)), levels too high to allow recovery through unassisted population growth based on the 0.34 mortality rate inflection point identified by Fuller et al. (2003).

Finally, biological and regulatory factors further constrain the growth of the Blue Range population in the face of high mortality and removal rates. Biologically, the low reproductive rates, small litter sizes, and potential low pup recruitment weaken the ability of the population to sustain continual losses. That is, the Mexican wolf is more susceptible to population decline at a given mortality rate than other gray wolf populations because of these biological attributes (AMOC and IFT 2005: TC-17). In addition, restrictions on initial releases in the BRWRA pursuant to the regulations associated with the Primary and Secondary Recovery Zones constrain the ability of management to take mediating action in response to high levels of mortality or removal in a given year, or to improve the population's growth rate and fitness through augmentation of the population's genetic variation to the degree research now suggests is necessary.

While it is not biologically reasonable to expect the population to track exactly with predictions or to increase every year, population swings over the last 5 years, coupled with a steady decline in the number of breeding pairs over the last 3 years, and inability of the project to achieve its objective to increase the minimum population by 10 percent in each of the last 2 years, indicate that the cumulative effects of identified threats coupled with the population's biological parameters are putting the population at risk of failure.

Summary statement: The Blue Range population is at risk of failure due to the cumulative effect of identified threats.

The Conservation Principles of Resiliency, Redundancy, and Representation

The principles of *resiliency*, *redundancy*, and *representation* represent a recently popularized conceptualization of key elements of biological diversity conservation (Shaffer and Stein 2000). These principles, although not specific to the purpose of guiding recovery efforts under the ESA, provide a useful framework for discussing scientific concepts relevant to gray wolf conservation, including demography, environmental variability, and genetics. As a collective, these principles do not represent formal, peer-reviewed principles that establish any particular standard for conservation. Rather, the Service has invoked the principles of *resiliency*, *redundancy*, and *representation* primarily as a communication tool to describe recovery efforts for the gray wolf in the Northern Rockies and Great Lakes (see 72 FR 6051-6103, February 8, 2007; 73 FR 10513-10560, February 27, 2008). For consistency, the conservation assessment will use these terms in similar fashion to consider the degree to which the Blue Range population contributes to recovery of the gray wolf in the Southwest. This discussion is ultimately constrained by a lack of objective and measurable recovery criteria, but important insights are nevertheless available. The conservation assessment describes and provides the scientific basis for each of the principles, examines relevant scientific literature, discusses how the principles have been applied in the Northern Rockies and Great Lakes gray wolf recovery programs, and describes the degree to which the Blue Range population fulfills each of the principles.

Summary statement: The Service has invoked the conservation principles of *resiliency*, *redundancy*, and *representation* to guide and communicate the fundamental components of gray wolf conservation and recovery.

Resiliency

The *resiliency* of a species or population can be measured by its ability to recover from disturbance and persist over time (Holling 1973). As a principle for guiding general conservation efforts across taxa, *resiliency* suggests that species that are more numerous and widespread are more *resilient* than those that are not (Shaffer and Stein 2000). Because population size has significant bearing on population persistence, consideration of *resiliency* can provide context for assessing the current reintroduction objective to establish a population of at least 100 wolves.

Scientific theory and practice generally agree that a species represented by a small population faces a higher risk of extinction than a species that is widely and abundantly distributed (Goodman 1987, Pimm et al. 1988). The primary cause of this susceptibility to extinction is the sensitivity of small populations to stochastic (that is, uncertain) demographic events (Shaffer 1987). That is, "The dynamics of a small population are governed by the specific fortunes of each of its few individuals. In contrast, the dynamics of a large population are governed by the law of averages (Caughley 1994: 217)." Sex ratios, survival, and reproduction may all be affected by demographic stochasticity. For example, in a given year or series of years, offspring could be predominantly one gender or the other, fewer individuals may survive, or reproduction may be below average, causing random population fluctuations. Even in a constant environment, the population trajectory for a small population will vary from year to year due to these events. In small populations, including those with a positive growth rate, it is more likely that a wide negative deviation from average birth or survival results could result in a decline toward extinction from which the population would not be able to recover (Mills 2007). Thus, as a population grows larger and individual events tend to average out, the population becomes less susceptible to demographic stochasticity. And, the higher the population growth rate, the more quickly persistence times will increase with increases in population size (Shaffer 1987). Population sizes considered "small" (that is, susceptible to demographic stochasticity) range from less than 30 individuals to over 100, depending on age structure (Boyce 1992: 487; Shaffer 1987: 73; Mills 2007: 101). There is not a single population size that will ensure persistence (Thomas 1990). Rather, populations of various sizes, vital rates, and biological and ecological characteristics will have different risks of extinction.

A variety of methods are available for estimating a species' likelihood of persistence, ranging from complex theoretical or simulation models to simple observation of existing populations (Shaffer 1981) or best professional judgment (Mills 2007). Population viability analysis (PVA) and minimum viable population (MVP) analysis are tools that have been used in the past to develop numerical population targets for ESA recovery efforts (Clark et al. 2002). Both typically entail the use of complex theoretical or simulation models. Minimum viable population can be defined as the smallest population size required for a population to have a predetermined probability of persistence for a given length of time (Shaffer 1981). Minimum viable population has fallen out of favor in recent years, having been replaced with the closely related probabilistic approach of PVA (see Gilpin and Soule 1986, Beissinger and McCullough 2002). Population viability analysis is similar to MVP but simply does not require specification of a minimum population size to maintain the species' viability (Boyce 1992); rather, model output will describe the species' likelihood of persistence over a given timeframe, for example, that at a population size of 500, a species has a 12 percent risk of extinction over the next 50 years (Beissinger and McCoullough 2002).

The specification of extinction risk and timeframe is typically subjective in viability modeling efforts; there is no single set of values generally deemed acceptable within the scientific community to describe a (minimally) viable population (Allendorf and Luikart 2007), nor does the ESA equate any such numeric values with endangerment or recovery (Vucetich et al. 2006). Rather, individual bias, and perhaps situational limitations, influence whether a 5 or 10 percent level of risk or a 50 or 500-year timeframe is appropriate for a given viability exercise. For example, Shaffer (1981: 132) defined a minimum viable population for any species as, "the smallest isolated population having a 99 percent chance of remaining extant for 1,000 years despite the foreseeable effects of demographic, environmental, and genetic stochasticity, and natural catastrophes."

Viability models can be tailored to consider questions about persistence based on information related to demography, genetics, management scenarios, or a host of other factors. Viability models developed to explore genetic issues (e.g., loss of diversity) may be quite different in structure and assumptions from models developed to explore demographic viability; for example, genetic PVAs may provide an effective population size opposed to a census (total) population size (see *Representation*, below). In some cases, models attempt to combine multiple kinds of information, such as genetics and demography, further contributing to their complexity. Although population viability analysis can provide powerful information when used appropriately, it is an intensive process with a number of shortcomings, including the subjective nature of determining appropriate extinction risk and time frame, time and cost necessary to gather adequate data, and the potential for results to be inappropriately applied in decision-making (Ewens et al. 1987, Boyce 1992, Mills 2007: 252-265, e.g., Patterson and Murray 2008).

Based on the above, it is not surprising that a brief literature review of wolf-specific population viability analyses and other estimations of wolf viability generate a range of results that can be difficult to compare or apply to recovery efforts. For example, Reed et al. (2003) incorporated age-structure, catastrophes, demographic stochasticity, environmental stochasticity, and inbreeding depression in an MVP analysis (99 percent probability of persistence for 40 generations) for a number of vertebrate species and recommended that minimum viable adult population size for the gray wolf was between approximately 1,400 and 6,300 wolves. Soule (1980) estimated an appropriate population size and area for short-term conservation for the gray wolf by incorporating data on wolf density, breeding structure, and carrying capacity, and recommended an absolute minimum effective population size of 100-200 wolves, or a census population size of at least 600 wolves and an area requirement of approximately 12,000 km^2 (4,633 mi^2), an area larger than Yellowstone National Park (Soule 1980: 163). Viability analysis of the gray wolf on Isle Royale predicted a population of 50 wolves would have a mean time to extinction of 73 years, with a 30 percent chance of surviving over 100 years (Vucetich et al. 1997). Theoretical analysis of this population demonstrated that an increase in the number of breeding units increased the mean time to extinction due to demographic stochasticity more strongly than an increase in population size, suggesting that the social structure of wolves may increase their susceptibility to demographic stochasticity compared with species in which breeding units are not limited to the number of social (breeding) groups in the population.

Empirical observation of several wolf populations in North America and Europe demonstrates that populations of several dozen to several hundred animals are able to persist for several decades (Fritts and Carbyn 1995, and see Fuller et al., 2003, Table 6.9). This may lead to the conclusion that empirical data demonstrates persistence of wolf populations at sizes considerably smaller than those suggested viable by modeling efforts. However, the drawbacks of basing viability estimations strictly on empirical data are several, mainly that persistence in the past does not guarantee or provide a future time horizon for persistence, and that site-specific circumstances (such as environmental variability) may not be applicable to other situations.

Several approaches to assess viability and extinction risk, often in combination, have been used by the Service in listing and recovery efforts for the gray wolf, including utilization of formal population viability analyses (IUCN 1996), literature survey (USFWS 1994: Appendix 9), expert-panels and best professional judgment (USFWS 1994: Appendix 9; USFWS 2002a), and threat analysis (e.g., 72 FR 6051-6103, February 8, 2007; 73 FR 10513-10560, February 27, 2008). Noticeably, estimations of viability vary not only between previous gray wolf recovery plans but also between those recovery plans and the scientific literature. There may be several reasons for this variability, including site-specific considerations, advances in analytical techniques and data availability used to explore viability over the last three decades, and the range of perceived notions of viability that exist within the professional community relative to wolf conservation and the ESA.

Two viability analyses were conducted specific to the Mexican wolf subsequent to the development of the 1982 Mexican Wolf Recovery Plan but prior to the reintroduction, but neither was completed after being subject to peer review (Seal 1990, IUCN 1996). In both cases, data from extant Mexican wolf populations in the wild was unavailable, so information from other wild and captive wolf populations and the Mexican wolf captive population was used in modeling simulations to assess the effects of various reintroduction and management scenarios. The 1990 Mexican wolf PVA incorporated life history data, carrying capacity, environmental stochasticity, and inbreeding depression. Summary results found that populations of fewer than 50 wolves had a high risk of extinction but that populations of 100 or more wolves had a less than 5 percent probability of extinction over a 100-year time span (Seal 1990). The 1996 PVA, which incorporated similar types of information as the 1990 analysis, was specifically targeted toward the upcoming reintroduction of Mexican wolves into the Blue Range. This analysis found that the simulated population experienced negative growth rates in scenarios with catastrophic events (i.e., drought) and had decreased viability in scenarios with inbreeding depression. Supplementation of the population of 1 adult pair of wolves and their offspring every 5 years virtually eliminated the risk of extinction caused by genetic factors during the 100-year time span, resulted in maintenance of population size around 100 wolves, and resulted in higher retention of genetic variation than in scenarios without management supplementation (although the model assumed that new individuals added to the population were unrelated to members of the existing population, which is unrealistic given the founding base of the captive population) (IUCN 1996).

In the Northern Rockies and Great Lakes gray wolf recovery programs, recovery criteria function as an indication of viability considered appropriate by the Service for delisting the gray wolf based on the specific circumstances of each of these programs. In the Northern Rockies, the Service developed and repeatedly reassessed recovery criteria based on best professional judgment. In the 1987 Northern Rocky Mountain Recovery Plan, which was developed by a recovery team, recovery criteria recommended establishment of a minimum of 10 breeding pairs for a minimum of three successive years in each of three core recovery areas, with connectivity between populations encouraged (USFWS 1987). These criteria were later revised based on literature survey, expert opinion, and best professional judgment, to 30 or more breeding pairs comprising some 300+ wolves in a metapopulation (a population that exists as partially isolated sets of subpopulations) with genetic exchange between subpopulations (USFWS 1994), in order to emphasize the importance of connectivity between populations. In the delisting of the Northern Rockies gray wolf distinct population segment, the Service acknowledged that the recovery criteria were likely a minimum standard for viability, supporting their position by pointing out that empirical evidence of wolf persistence demonstrates greater persistence than theory suggests (73 FR 10513-10560, February 27, 2008, and see Fritts and Carbyn 1995). In the Great Lakes gray wolf recovery program, recovery criteria specified the establishment of a Minnesota wolf population of 1,250-1,400 wolves, with establishment of a second population of either 100 wolves if located within 100 miles of the Minnesota population, or 200 wolves if located more than 100 miles from the Minnesota population demonstrating persistence for at least 5 years (USFWS 1992: 28). These criteria were also developed based on best professional judgment of viability by members of a recovery team.

Due to the large area requirements of wolves (see “factor (A)”), area size is a feature of *resiliency* that is necessary to support viability and persistence. The area required to support a viable population depends on how a viable population is defined; clearly the area needed to support a population of several 100 wolves for several generations would be different than the area needed to support several 1,000 wolves for 100 or more years. Of equal importance, the area required to support a viable population would depend on the quality and configuration of habitat, with high quality habitat likely supporting a higher density of wolves than low quality habitat. Effective recovery strategies in the Northern Rockies and Great Lakes gray wolf recovery programs have focused on establishing wolf populations in high quality core habitats surrounded by lower quality habitat supporting lower densities of prey and wolves. In the Southwest, lower prey densities due to the arid environment (Bednarz 1988) may necessitate larger areas to support a population of a given size compared with more productive habitat in the Northern Rockies or Great Lakes.

Given all of this information, what can be said about the current *resiliency* of the Blue Range population? Qualitatively, the population faces significant, although unquantified, extinction risk from demographic stochasticity due to the sheer fact that the population numbers only 42 wolves. The captive population, while critical to the reintroduction, is not intended to serve as a safety net for extirpation of the Blue Range population. The ability of the population to increase rapidly in size and outgrow this susceptibility is constrained by several factors, including the low reproductive and/or recruitment rate and high levels of mortality and removal (see “Gray Wolf Biology and Ecology” and “factor (D)”). Further, the viability of the population when it reaches its target of at least 100 wolves remains unquantified, although qualitatively this target is significantly below estimates of viability appearing in the scientific literature or in other gray wolf recovery plans. Thus, while attaining the population target will satisfy the project’s objective, it does not mean that a viable population has been established. Finally, although it is readily apparent that the current reintroduction is an essential component of establishing an acceptable level of *resiliency* in the Southwest, recovery criteria specifying a population number appropriate for delisting have not been developed, limiting determination of the extent to which the current population target contributes to recovery.

Summary statement: Prior Service gray wolf recovery plans in the Great Lakes and Northern Rockies have considered “viable” wolf populations to range from several 100 to over 1,000 wolves. Results from gray wolf viability modeling in the scientific literature provide a wide range of population sizes, extinction probabilities, and time frames for viability.

Summary statement: The extinction risk of the current Blue Range population or the viability of the BRWRA population target of at least 100 wolves has not been precisely quantified because a current, complete, peer-reviewed viability analysis based on Mexican wolf data from the captive or reintroduced population has not been conducted. Thus, attaining the population target satisfies the project's objective, but does not mean that a viable population has been established.

Summary statement: The Service has not specified the viability (typically in the form of recovery criteria in an up-to-date recovery plan) that should be achieved for the gray wolf recovery program in the Southwest. However, scientific tools are readily available for assessing viability and developing recovery criteria, including PVA, empirical observation, and best professional judgment.

Redundancy

Redundancy refers to the existence of redundant, or multiple, populations spread throughout a species' range. It addresses the adage, "Don't put all your eggs in one basket" and advances the notion that a species' likelihood of persistence generally increases with an increase in the number of sites it inhabits (Shaffer and Stein 2000). The need for *redundancy* is not a statement in support of the trade-off between establishing multiple, small populations over a single large population; rather it supports establishment and maintenance of multiple *resilient* populations as preferable to establishment and maintenance of one *resilient* population. That is, maintenance of multiple populations, rather than a single population, confers a benefit to the ability of a species to persist because it allows for populations to exist under different abiotic and biotic conditions, thereby providing a margin of safety that random perturbation (or, variation) affects only one, or a few, but not all, populations (Shaffer and Stein 2000). Thus, the principle of *redundancy* can be used to provide context for assessing the adequacy of the establishment of a single wolf population in the Southwest.

Random variations in the environment that in turn affect the demography of a population are referred to as environmental stochasticity (Shaffer 1987). Environmental stochasticity, unlike demographic stochasticity, is not dependent on small population size and operates on populations of all sizes (Shaffer 1987, Mills 2007:103). Environmental stochasticity may take the form of variation in available resources (e.g., prey base), or in direct mortality (e.g., a disease epidemic), but either way results in variation in population growth rate (Shaffer 1987, Caughley 1994). Extreme environmental events, referred to as catastrophic, including events such as wildfire, drought, or a disease epidemic, may result in drastic, rapid population declines (Shaffer 1987). Consideration of environmental stochasticity would suggest that as the number of populations established increases, extinction risk of the species decreases.

The scientific literature does not recommend a specific number or range of populations appropriate for conservation efforts, although rule of thumb guidelines for the reintroduction of a species from captivity recommends that at least two populations be established that are demographically and environmentally independent (Allendorf and Luikart 2007: 472). Beyond this instruction, the need for redundancy is probably best described as a case-specific determination based on the conservation goal and the species' characteristics (e.g., longevity, dispersal behavior, mating structure). For a goal of recovering a species under the ESA, *redundancy* may contribute to the determination of "significant portion of range" in the definitions of threatened and endangered and contributes to returning a species to a self-sustaining dynamic in the wild.

When a species is distributed in *redundant* populations, there are two possible relationships between the populations: they can be completely isolated from each other, or they can be connected with one another through the dispersal (also referred to as "migration" in the genetic literature) of individual animals. There are benefits and drawbacks to either relationship. For example, disease transmission will not occur between populations that are completely isolated from one another. However, immigration can bolster population size through arrival of new individuals (demographic rescue) (Brown and Kodric-Brown 1977), and if individuals successfully mate, can affect the genetic fitness of a population (Allendorf and Luikart 2007). If connectivity between populations is desired, conservation efforts must ensure that the distance between populations is compatible with wolf dispersal abilities and that the habitat through which individuals will be dispersing is of sufficient quality and quantity to support immigration. Alternatively, artificial immigration between populations can be accomplished through the translocation of wolves by management. Wolves generally have good dispersal ability through a variety of habitats, including heavily modified habitat (Fritts et al. 2003).

Support for *redundancy* as a feature of gray wolf recovery is provided by knowledge of historical gray wolf distribution patterns. Although some species are naturally distributed as endemics in a single or few localized populations, the gray wolf was historically widespread in North America in numerous populations connected by dispersal (including Mexican wolves in the Southwest and Mexico), supporting the conclusion that *redundancy* is a fundamental component of natural wolf distribution.

The necessity of establishing multiple populations has been central to the Service's gray wolf recovery programs in the Northern Rockies and Great Lakes. In both areas, the need for *redundancy* was examined within local circumstances, including habitat availability and connectivity, existing and desired levels of genetic diversity, and estimations of necessary demographic viability. In the Great Lakes, recovery criteria for delisting called for the establishment of two populations, explaining that:

> The requirement for more than a single recovery population stems from the basic concept of conservation biology that a species can never be assumed to be secure from extinction if only a single population exists…The only satisfactory means of reducing the threat of extinction…is to ensure that more than a single population is established prior to declaring the species recovered (USFWS 1992: 24).

Two populations, in this case, were considered minimally acceptable by the Eastern Timber Wolf recovery team at the time, although there was general agreement that additional populations would have provided increased security (USFWS 1992:24). In the Northern Rockies, gray wolf recovery criteria initially called for the establishment of three populations, later revised to require establishment of a metapopulation with genetic exchange between subpopulations (USFWS 1987:10, USFWS 1994, USFWS 2002a).

In both the Great Lakes and Northern Rockies, connectivity between *redundant* populations has been an important consideration (USFWS 1994, USFWS 2002a). In the Great Lakes, the distance between the two populations, which determined the likelihood of (demographic and genetic) connectivity, influenced the population size deemed adequate for viability of the smaller population (USFWS 1992: 25). In the Northern Rockies, revised recovery criteria recommended connectivity via wolf dispersal between the three subpopulations to ensure maintenance of genetic diversity in each subpopulation as well as the overall metapopulation (USFWS 1994, USFWS 2002a).

Numerous habitat assessments have been conducted to identify possible areas for reestablishment of the gray wolf in Arizona, New Mexico, Utah, Colorado, and Mexico. These studies, which are listed in chronological order, encompass a range of techniques and types of data and therefore as a collective provide only general insight as to the potential for redundancy (and ecosystem *representation*, see *Representation*, below) in the Southwest.

Summary of Information on Four Potential Mexican Wolf Reintroduction Areas in Arizona
Johnson et al. (1992) compiled information on land area and ownership, precipitation, topography and vegetation, prey density, livestock use, competitors and predators, threatened and endangered species, human density, road density, future habitat alterations, and potential locations for pre-release acclimation enclosures in their analysis of four areas under consideration for Mexican wolf reintroduction in Arizona: the Blue Range Primitive Area, Chiricahua Mountains, Galiuro and Pinaleno Mountains, and Atascosa and Patagonia Mountains. The Blue Range Primitive Area, followed by the Atascosa and Patagonia Mountains, contained the most suitable features of the four sites.

Colorado gray wolf recovery: a biological feasibility study
Bennett (1994) analyzed lands in Colorado designated as National Forests by the USDA-Forest Service, utilizing information on Forest area, percentage of public land of adjoining counties, mule deer and elk biomass, human density in adjoining county block, percentage of wilderness area in relation to National Forest area, road density, cattle density, level of recreational use, annual snowfall, and projected carrying capacity of wolves based on ungulate biomass. Seven areas were identified as "Potential Wolf Recovery Areas": Arapho-Roosevelt PWRA, Grand Mesa-Uncompahgre-Gunnison PWRA, Pike-San Isabel PWRA, Rio Grande PWRA, Routt PWRA, San Juan PWRA, and White River PWRA. Of these sites, all or portions of five sites were identified as good or satisfactory for wolf establishment, with issues related to livestock and human density being cited as primary deterrents in all or portions of four sites that would need to be addressed before reintroduction could be recommended.

Wolves in the Southern Rockies: report from the population and habitat viability workshop
Workshop participants assessed the suitability of 10 subregions within the Southern Rockies ecoregion for the reestablishment of wolf populations. Subregions were identified based on habitat factors such as prey abundance and availability, topography, land ownership, and road density. Viability predictions for each region were not finalized (Phillips et al. 2000).

The feasibility of gray wolf reintroduction to the Grand Canyon ecoregion
Sneed (2001) analyzed six biophysical and human-related factors to determine the feasibility of gray wolf reintroduction to the Arizona portion of the Grand Canyon: vegetation cover,

surface water, ungulate prey abundance, human population density, road density, and land status. The North Kaibab and the South Colorado Plateau were identified as potentially appropriate for establishment of the (Mexican) gray wolf.

Impacts of landscape change on wolf restoration success in the Southern Rocky Mountain Ecoregion

Carroll et al. (2003) identified four potential reintroduction sites in the Southern Rocky Mountains Ecoregion (southern Wyoming, Colorado, and Northern New Mexico) with the ability to support gray wolf populations of varying sizes and extinction risk, based on habitat variables including vegetation, satellite imagery metrics, topography, climate, and human-impact and life history data. The sites included northern New Mexico, southwest Colorado, west-central Colorado, and northwestern Colorado. Projections for the year 2025, which took into account human population growth and resultant road development, generally demonstrated decreased carrying capacity of habitat and higher extinction risk of populations than current conditions.

Spatial analysis of restoration potential and population viability of the wolf (Canis lupus) in the southwestern United States and northern Mexico

Carroll et al. (2005) used life history data and habitat variables associated with vegetation, satellite imagery metrics, topography, climate, and human-impact to analyze five potential sites for gray wolf reestablishment in the southwestern United States (BRWRA in Arizona/New Mexico, Grand Canyon in Arizona, Mogollon Rim in Arizona, San Juans in Colorado, and Vermejo/Carson in northern New Mexico) and potential sites in Mexico (the Austin Ranch area located in Chihuahua/Sonora near the United States border, Carmen in northern Coahuila, northwestern Durango, and the Tutuaca reserve area in westcentral Chihuahua) in order to predict the vulnerability of sites to landscape change. Scenarios included current conditions, future conditions in the year 2025 based on human population growth and landscape development. Results for the United States portion of the analysis demonstrated decreased carrying capacity of sites, decreased connectivity, and increased extinction risk over time due to landscape development.

Defining recovery goals and strategies for endangered species: the wolf as a case study

Carroll et al. (2006) analyzed potential wolf habitat across the western United States from the western edge of the Great Plains to the Pacific Ocean, using information on wolf life history, demography, and habitat variables (see Carroll et al. 2003). They specifically simulated reintroduction scenarios for the SWDPS (Arizona, New Mexico, western portions of Texas and Oklahoma, and southern portions of Colorado and Utah; see Status and Implications of National Gray Wolf Recovery for the Mexican Wolf, above) to identify and compare potential reintroduction sites now and projected for the year 2025. Four potential reintroduction sites were identified: Carson (Northern New Mexico), the Grand Canyon (Northern Arizona), the Mogollon Rim (central Arizona), and the San Juan Mountains (southwestern Colorado).

Places for Wolves: A Blueprint for Restoration and Recovery in the Lower 48 States

Defenders of Wildlife (2006) reviewed existing studies of wolf suitability for the continental United States. They identified several sites for gray wolf restoration in the Southern Rockies

Ecoregion, including southern Wyoming, northern New Mexico (Vermejo Ranch and Carson National Forest), and the southern Rocky Mountains in Colorado, including the San Juan Mountains, Flat Tops, and Grand Mesa areas. In the Southwest, the Grand Canyon Ecoregion (the area surrounding the Grand Canyon and the Kaibab plateau) is recognized as one of the best places for wolves based on Sneed (2001) and Carroll et al. (2003 and 2006), summarized here. They also recommend Big Bend National Park and the Black Gap Wildlife Management Area in Texas, and the Sky Islands region of southern Arizona and New Mexico. In Mexico, they identified the Sierra San Luis/Sierra Los Azules complex in northwest Mexico, the Sierra del Carmen/Serranias del Burro complex in northeast Mexico, the Sierra Plegada in Nuevo Leon, and northwestern Durango and western Zacatecas as containing suitable wolf habitat.

<u>*Mexican Wolf Reintroduction Workshop Final Report: Evaluation of Potential Release Sites*</u>
Three large zones have been identified by habitat-based modeling as appropriate for Mexican wolf reintroduction in Mexico (Araiza et al. 2006). These include: Sierra Madre Occidental - North Zone, which includes portions of Chihuahua and Sonora; Sierra Madre Occidental - South Zone, which includes portions of Chihuahua, Durango, Zacatecas, and Aguascalientes; and Sierra Madre Oriental, which includes portions of Nuevo Leon and Coahila.

Summary statement: Establishment of only a single Mexican wolf population in the Southwest provides the least amount of *redundancy*, and therefore the least amount of security from environmental perturbation possible.

Summary statement: The number of *redundant* populations and related connectivity appropriate for recovery in the Southwest has not been specified; therefore, the degree to which the Blue Range population contributes to redundancy cannot be quantitatively determined.

Summary statement: For a species that has been extirpated from so much of its historic range, explicit effort must be made to recreate *redundancy*.

Summary statement: Results from numerous efforts to identify suitable wolf habitat in the Southwest over the past two decades are available.

Representation
Representation refers to the genetic variation represented by members of a population or species, specifying that higher levels of variation better support ecological and evolutionary processes than low (Shaffer and Stein 2000). *Representation* asserts that a species should be able to persist within the range of future habitat conditions that it may encounter (Shaffer and Stein 2000). Thus, *representation* allows for consideration of the short-term maintenance of fitness and vigor of individuals, and long-term maintenance of the species' adaptive potential (Soule 1980). *Representation* therefore provides context for considering the short and long-term genetic fitness of the captive and reintroduced Mexican wolf populations.

On a much broader scale, *representation* also suggests that a species should be conserved in the variety of habitats in which it occurs in order to maintain the structure and function of ecosystems, i.e., ecosystem *representation* (Shaffer and Stein 2000). Although most conservation efforts under the ESA are directed at single-species, this type of *representation* aligns with one of the primary purposes of the statute, "to provide a means whereby the ecosystems upon which endangered species and threatened species may be conserved" 16 U.S.C 1531(b). Thus, both genetic and ecosystem *representation* will be considered.

Attention to a population's genetic structure and diversity is often a critical component of conservation efforts, and is particularly of interest in small populations due to the process of genetic drift, the change in allele frequencies represented in a population from one generation to the next due to random mating events (Allendorf and Luikart 2007). Genetic drift occurs in all natural populations, but is inversely related to its size; that is, greater changes in allele frequencies occur in small populations over time than in large, simply due to chance (Mills 2007). Genetic drift results in a decrease in heterozygosity and an increase in homozygosity (Allendorf and Luikart 2007: 122), which can result in decreased individual fitness and decreased adaptive potential of the population (Franklin 1980, Soule 1980, Lande and Barrowclough 1987, Allendorf and Luikart 2007). Thus, the genetic effects of small population size can influence the persistence of a population through several outcomes, including loss of phenotypic variation, loss of adaptive potential, and the buildup of harmful mutations (Allendorf and Ryman 2002). Small populations are also at greater risk of inbreeding depression (reduced fitness and vigor due to increased homozygosity or reduced heterozygosity resulting from the mating of related individuals) due to the smaller pool of unrelated potential mates available as compared to a larger population (see "factor (E)").

Due to the small number of wolves available to found the Mexican wolf captive breeding program (seven animals, representing three lineages), intensive management of genetic variation is an integral component of the recovery effort. Management of the captive population has focused on ensuring appropriate representation of genes from each of the three founding lineages in the captive population for both short-term and long-term genetic fitness (see "factor (E)"). Because there are no known remaining wild Mexican wolves that can be brought into captivity to increase the genetic variation of the captive population, the continued maximization of overall gene diversity retention (avoidance of genetic drift) and minimization of inbreeding is critical for the future of the recovery program (Siminski and Spevak 2007, and see "factor (E)"). Ultimately, the purpose of the captive breeding program is to enable the reintroduction of the Mexican wolf to the wild, thus the maintenance of genetic variation in the captive population is only meaningful if this variation is transferred to the reintroduced population so that the fitness and long-term adaptive potential of the Mexican wolf in the wild is ensured. As discussed in "factor (E)", genetic considerations are an important, but not consistently prioritized, component of Blue Range population management.

The current retained gene diversity (83.10 percent of the founding population) in the Mexican wolf captive population is lower than some captive breeding programs due to the small number of founders and a significant loss of genetic diversity from the management of the lineages prior to SSP involvement (Siminski and Spevak 2008). Conservation breeding programs typically strive to maintain at least 90 percent of the genetic diversity at the time of establishment to avoid the potential for lower birth weights, smaller litter sites, and greater neonatal mortality (Allendorf and Luikart 2007). According to the 2008 Species Survival Plan Population Analysis and Breeding Plan, the captive population will retain approximately 75 percent of its gene diversity over the next 37 years. Diversity will decrease to 63.12 percent after 100 years, unless carrying capacity of the captive facilities can be increased to allow for an increase in annual population growth rates and in effective population size (see below), which will improve genetic retention. Currently, the carrying capacity of the captive facilities is about 300 captive wolves, which has been reached by the existing population (Siminski and Spevak 2008). The overall gene diversity of the Blue Range population of Mexican wolves (78.81 percent and 2.36 Founder Genome Equivalents, as of July 25, 2008) is lower than that of the captive population, which is expected given that the wild population was started using wolves that were well-represented in the captive population (Siminski and Spevak 2008). Recent research also demonstrates that evolution of the population's genome over prolonged time spent in captivity can reduce survival when captive animals are released to the wild, as traits that are adaptive to the captive environment can be maladaptive in the wild (Frankham 2008); to date, no explicit investigation of whether these findings hold true for the Mexican wolf captive and reintroduced populations has occurred.

Importantly, it is the effective population size, rather than the census population size (as for demographic stochasticity), that primarily determines the rate of loss of heterozygosity, change in allele frequencies, and rate of inbreeding increase over time in a population (Waples 2002, and see Lande and Barrowclaugh 1987), and thus is a useful measure of *representation*. Effective population size (N_e) is defined as "the size of the ideal population (N) that will result in the same amount of genetic drift as in the actual population being considered" (Allendorf and Luikart 2007: 148, also see Waples 2002: 149). Effective population size takes into account that not all members of a population reproduce every year; some may be too old, too young, not find a mate, or myriad other possibilities. Of those individuals that do mate, contributions to the next generation may differ due to an unequal sex ratio, number of offspring produced, survival of offspring, or other factors. An increase in effective population size results in a decrease in the rate of genetic drift or likelihood of inbreeding (i.e., genetic stochasticity) experienced by a population (Mills 2007: 180).

Several general (non-species specific) rules of thumb have been presented in the scientific literature to inform efforts for conservation of a species' or populations' genetic diversity. As with other estimations and recommendations of viability, these rules of thumb are not intended for verbatim application. The ESA does not require any particular level of genetic diversity as a component of recovery, rather genetic diversity is typically considered by the Service in relation to threats or extinction risk depending on each species' circumstances.

Perhaps the most commonly cited genetically-based minimum viable population estimate is the 50/500 "rule" (Franklin 1980, Soule 1980), where the "50" represents a recommendation of the effective population size deemed adequate to maintain short-term fitness loss due to inbreeding (1 percent level of inbreeding per generation), and the "500" is the effective population size deemed adequate for the long-term maintenance of adaptive potential. These guidelines were developed as a general conservation recommendation for captive efforts based solely on genetic information without regard to other factors that may impact a species' long-term persistence (Mills 2007: 250). Lande and Barrowclaugh (1987) revisited the “500” recommendation, and concluded more generally that an effective population size of at least several hundred individuals would likely be necessary to maintain adaptive potential in most wildlife populations. Thomas (1990) suggested that a (census) population between 100 and 1,000 individuals would likely be adequate. Subsequently, Lande (1995) argued that the 50/500 rule is an order of magnitude too small and suggested that effective population sizes should be in the 1,000s based on the potential effects of mutation on population viability.

Determination of an appropriate effective population size (and extrapolation of a census population size) for conservation efforts may identify a population size that is too large for any one contiguous area to support. Thus, effective population size could adequately be achieved by establishing multiple populations that collectively total the necessary effective population size (Allendorf and Luikart 2007: 374). This situation would require specification of the level of connectivity needed between subpopulations to ensure that genetic migration occurs. One migrant per generation (successfully reproducing) has been recommended, although not specific to the Mexican wolf (Allendorf 1983, Lacy 1987, Lande and Barrowclaugh 1987). This connectivity may present an opposing force to the potential for divergence of otherwise isolated populations stemming from natural selection and mutation (Allendorf and Luikart 2007: 206).

For the gray wolf, social structure greatly affects effective population size. That is, in a population of 100 wolves, not all 100 wolves are reproductively active; rather, some proportion of those wolves will breed from year to year. Effective population size for the Mexican gray wolf in the Blue Range population has been estimated at 0.28 times the census population (range of 0.19 to 0.34) as calculated from the annual number of breeding adults in the population divided by the total population, not including adults or pups that die during the year (USFWS 2002b, USFWS 2003, USFWS 2004, USFWS 2005, USFWS 2006a, AGFD et al. 2007). Based on this calculation, at the population target of 100 wolves, effective population size would be around 28 wolves. This estimate may be biased high, as the annual BRWRA population count is a minimum count. Further, effective population size is influenced by pack size, which is relatively small in the Blue Range compared with other wild wolf populations. However, this effective population size falls within the range of general estimates of effective population size for wildlife populations provided in recent scientific literature (0.2-0.3, see Mills 2007: 185). The effective population size of the captive Mexican wolf population in 2008 was approximately 34 wolves (N_e/N ratio of 0.12) (Siminski and Spevak 2008).

The recovery programs for the gray wolf in the Great Lakes and Northern Rockies provide minimal instruction for the application of genetic *representation* in the Southwest because their circumstances differ sufficiently from the Southwest. Neither program has maintained a strict conservation focus on a subspecies of gray wolf as has the Southwest on the Mexican wolf or depended on a captive breeding program for reestablishment of wild populations, and both programs continue to depend in part on connectivity to large, healthy wolf populations in Canada for establishment, infusion, and maintenance of genetic diversity (72 FR 6051-6103, February 8, 2007; 73 FR 10513-10560, February 27, 2008). In both programs, connectivity among regional subpopulations has been an important component of recovery criteria for the maintenance of genetic diversity (see USFWS 1992, USFWS 1994, USFWS 2002a). There is a future possibility of immigration of wolves (and thus of new genetic material) between regional recovery areas (e.g., a Northern Rockies wolf dispersing to the Southwest and breeding with a Mexican wolf), although this will depend in large part on future decisions related to the state management of delisted wolves in the Great Lakes and Northern Rockies, modification of BRWRA boundaries, expansion of the Southwest's gray wolf recovery effort, and future habitat conditions. This would present a new set of genetic considerations for the Southwest related to the purity of the Mexican wolf, inbreeding, and adaptive potential.

Summary statement: Effective population size is a useful measure of genetic *representation*. Gray wolves' social (mating) structure strongly influences effective population size. The scientific literature presents a range of appropriate effective population sizes for short-term fitness and long-term adaptive potential, ranging from dozens to thousands of individuals.

Summary statement: Maximization of long-term (several generations) genetic retention is a priority for the captive breeding program. Loss of gene diversity in the captive population can be slowed by increasing the effective population size of the population and increasing its growth rate, both of which are currently constrained by the space available in captive facilities. For the purpose of the reintroduction, the success of the captive program is only meaningful if genetic variation is transferred to the wild population.

Summary statement: An appropriate effective population size or other genetic-related objectives for regional gray wolf recovery in the Southwest has not been determined.

Consideration of ecosystem *representation*, which specifies that a species should be conserved in the variety of habitats in which it occurs in order to maintain the structure and function of ecosystems, requires acknowledgement that species are both dependent on the integrity of the ecosystems in which they occur as well as responsible for the integrity of ecosystems in which they occur. Recent scientific exploration of the emerging concept of "ecologically effective densities" supports the recovery of strongly interacting species such as wolves to densities at which they provide ecosystem-level effects (e.g., trophic cascade, see "Gray Wolf Biology and Ecology: Ecology and Habitat Description") (Soule et al. 2003, Soule et al. 2005). At the ecosystem level of *representation*, the Mexican wolf currently inhabits only the BRWRA, and therefore is not conserved in a variety of habitats. Gray wolves used to inhabit much of the Southwest, from its southern-most extent (including the central highlands of Mexico), through the Southern Rockies, an area that included a variety of habitat types ranging from semi-desert grasslands to coniferous forests. Although the ESA does not mandate that a species be reestablished throughout its historic range or in all of the habitat types in which it historically occurred in order to achieve recovery, it does promote the conservation of ecosystems that support listed species. It also requires that the species not be "in danger of extinction throughout all or a significant portion of its range." 16 U.S.C. 1532(6) (definition of endangered species). These considerations lend credence to the inclusion of ecosystem *representation* as a component of conservation and recovery efforts.

Prior gray wolf recovery plans in the Great Lakes and Northern Rockies did not include consideration of ecosystem *representation* as an explicit component of recovery criteria, although the Service indirectly addressed ecosystem *representation* through the analysis of significance for delineation of both DPSs (72 FR 6059-6060, February 8, 2007; 73 FR 10520, February 27, 2008). Collectively, the three regional gray wolf recovery programs achieve some degree of ecosystem *representation*, as they have resulted in the reestablishment of the gray wolf in a variety of significantly differing habitats in North America.

Summary statement: The degree to which ecosystem representation should be a component of conservation and recovery efforts in the Southwest is unclear based on minimal consideration of the concept by the Service in other gray wolf recovery efforts, nor has any determination of ecosystem representation been made for the Southwest. Without this information, the degree to which the Blue Range population contributes to regional ecosystem *representation* cannot be evaluated, except to say that the Mexican wolf has not been reestablished in all or most of its former range.

CONCLUSION

The effort to save the Mexican wolf from extinction has been ongoing since 1976. Today, the Mexican wolf recovery effort consists of an extensive international network of Mexican wolf captive breeding facilities and a single nonessential experimental population of Mexican wolves in Arizona and New Mexico. The Service is joined by a large number of Federal, State, County, Tribal, non-profit or non-governmental organizations, educational institutions, private individuals, and other groups in the Mexican wolf recovery effort.

The Blue Range population, although successfully established since 1998, is not thriving. Over the last 5 years, the population's size has hovered around the halfway point of the population target of at least 100 wolves, and the number of breeding pairs (as defined by the Final Rule) has dropped to 2. Threats hindering the biological progress of the population and success of the recovery program include management and regulatory mechanisms, such as regulations associated with the internal and external boundaries of the BRWRA, and lack of an up-to-date recovery plan; illegal shooting; and inbreeding. Although no single threat is single-handedly responsible for the delayed progress of the reintroduction or the recent decline in population size and number of breeding pairs, the cumulative effect of these threats results in a consistently high level of mortality, removal, and reduced fitness that, when combined with several biological parameters, threatens the population with failure. The longer these threats persist, the greater the challenges for recovery, particularly as related to genetic fitness and long-term adaptive potential of the population.

The success of the reintroduction project is important not only for its own sake, but also as a significant contribution to recovery of the gray wolf in the Southwest. The intent of the ESA is to recover species such that they are able to sustain themselves in the wild. A "recovered" species is not one that has a zero chance of extinction; rather, it has a risk of extinction that is deemed acceptable for Federal protections to be removed with a high degree of certainty that the species is and will continue to be self-sustaining in the wild. Although some degree of management intervention may be necessary after delisting for a wide-ranging, socially controversial predator such as the wolf, such intervention should serve to make minor adjustments when necessary within a reasonable range of population fluctuation, not serve as a major hedge against extinction.

Application of the conservation principles of *resiliency*, *redundancy*, and *representation* provide insight into the contributions of the Blue Range reintroduction project to regional gray wolf recovery. Exploration of demographic stochasticity (*resiliency*) demonstrates that at its current population size of around 50 wolves, the Blue Range population is vulnerable to stochastic demographic events; this vulnerability will decrease as the population increases in size. Further, a population target of more than 100 wolves will be necessary to ensure adequate viability for recovery. Exploration of environmental stochasticity (*redundancy*) demonstrates that establishment of more than one population would lessen extinction risk for the Mexican wolf by providing safety from environmental perturbations; that is, establishment of a single population is inadequate for recovery. Exploration of genetic *representation* demonstrates that the short-term genetic fitness and long-term adaptive potential of a population are best supported by establishing larger, rather than smaller, effective population sizes. Based on current estimates extrapolated to the population target of 100, an effective population size of 28 wolves is not adequate to ensure short or long-term genetic fitness for the Mexican wolf. Finally, ecosystem *representation* suggests that the distribution and connectivity of the gray wolf in a variety of habitats in the Southwest and into Mexico is an important consideration for ecosystem health and diversity. Thus, although the precise quantification of the Blue Range population's contributions to *resiliency*, *redundancy*, and *representation* are ultimately limited by a lack of objective and measurable recovery criteria, it is clear that establishment of a single population of at least 100 wolves does not achieve *resiliency*, *redundancy*, or *representation*.

Consideration of several factors will influence the creation of an appropriate formulation of recovery for the gray wolf in the Southwest. First, the principles of r*esiliency*, *redundancy*, and *representation* are, to some degree, interdependent. This means that the degree to which one is realized may affect and in turn be affected by the degree to which the others are realized. For example, *representation* may be affected by the number and connectivity of disjunct populations (*redundancy*), thus *redundancy* may be necessary not only to address environmental variability, but also to achieve appropriate levels of *representation*. This flexibility may be beneficial for application to recovery efforts because it allows for trade-offs to be made based on site-specific considerations to ensure effective implementation of conservation actions. Simply put, these principles support a range of appropriate formulations for gray wolf recovery. Second, biological and ecological factors may influence the determination of appropriate levels of *resiliency*, *redundancy*, and *representation*; for example, the aridity of the southwestern landscape and future development patterns will influence habitat suitability. Finally, the social and economic circumstances of the Southwest create a unique backdrop for gray wolf recovery efforts, and scientific determinations of *resiliency*, *redundancy*, and *representation* will be accompanied by considerations of social and economic factors. Moreover, resolution of litigation and policy decisions will continue to shape recovery efforts at the regional and national level.

Substantial progress in securing the Mexican wolf from extinction has been made over the last 30 years. Given this progress, and in light of the Blue Range population's current status, it is time to shift the focus of the recovery program from the "brink of extinction" toward pursuit of full recovery.

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APPENDIX A: FIGURES AND TABLES

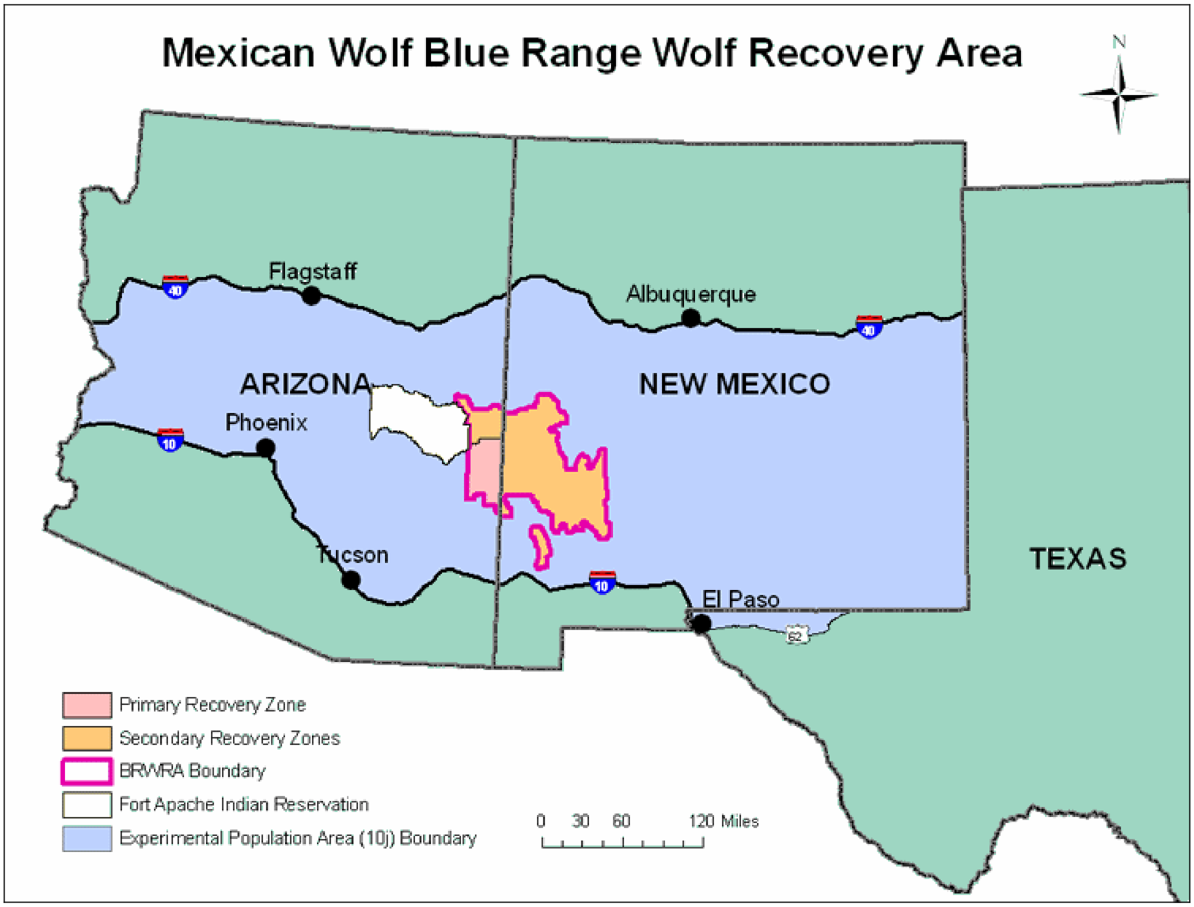

Figure 1: Mexican Wolf Blue Range Wolf Recovery Area. USFWS.


Figure 2. Photo of Mexican wolf. USFWS.

Table 1. Mexican Wolf Blue Range Reintroduction Project Statistics. USFWS.

Minimum population count and number of breeding pairs within the Blue Range Wolf Recovery Area, Arizona and New Mexico, compared to the 1996 Final Environmental Impact Statement, 1998 to 2008.

Population count			No. of breeding pairs	
Year	Minimum	FEIS prediction	Minimum	FEIS prediction
1998	4	7	0	1
1999	15	14	0	2
2000	22	23	1	4
2001	26	35	3	6
2002	42	45	5	8
2003	55	55	3	10
2004	44-48	68	6	12
2005	35-49	83	5	15
2006	59	102	7	18
2007	52	*	4	*
2008	52	*	2	*
2009	42	*	2	*

APPENDIX B. PUBLIC AND PEER REVIEW COMMENTS

Comments received during the public and peer review comment periods on the draft conservation assessment are summarized below. Comments that do not directly relate to the conservation assessment (e.g., general opinions about wolf reintroduction) are not summarized. Non-substantive editorial comments such as grammar or spelling corrections, the addition or deletion of a word, or the clarification of a word or phrase have been incorporated directly into the final conservation assessment. Wording suggestions for text that has been eliminated from the document are not summarized. Section titles and page numbers referenced in comments refer to the draft document and may have changed between the draft and final versions of the conservation assessment. Likewise, comments are organized by the section title from the draft document (with the exception of the category "General", which contains comments not directly applicable to one portion of the document). All comments received are retained in the Service's administrative files.

General

Comment: The Service should allow an opportunity for the public to evaluate whether comments were accurately and adequately considered and incorporated into the final conservation assessment.

Response: As stated in the "Foreword", the conservation assessment is not a document required or defined by the ESA. Therefore, the procedures for public notice and review of the conservation assessment are not specified by regulation. However, the Service is following public notice and review procedures pursuant to the APA and section 4(f) of the ESA for recovery planning. That is, after public notice and review of the document and incorporation of comments, a final conservation assessment will be published without an additional public review opportunity.

Comment: The Service should redirect resources for finishing the Mexican Wolf Conservation Assessment to replacing SOP 13 with reasonable limits on regulated take, returning control of the reintroduction program to the Service, and developing an up-to-date recovery plan for Mexican wolves.

Response: The Service considers the resources required to complete the conservation assessment a worthwhile expenditure because the document provides useful information for recovery planning. The assessment can also be used to inform future policy and management decisions, such as revision of SOPs and workload planning. One of the primary purposes of the assessment is to capture the progress made by the 2003 SWDPS recovery team; not finalizing the assessment would make their work more difficult to recapture as time passes. The Service will make no further decisions that relate to the Mexican Wolf Recovery Program pursuant to SOP 13 as issued on April 30, 2005, or as altered by the Clarification Memo on May 28, 2009. The Service recognizes that the AMOC does not oversee the actions of the Service and that the AMOC has no decision-making authority over the Service with regard to the Service's management of the Mexican Wolf Recovery Program or the Mexican Wolf Reintroduction Project

Comment: The use of the term "Blue Range population" (wolves in the BRWRA and the FAIR) is acceptable informally, but the Final Rule and the FEIS establish a population

objective of at least 100 wolves in the BRWRA, legally defined in the Final Rule as the entirety of the Apache and Gila National Forests. Counting wolves outside of the BRWRA cannot be used to mask the failure of the reintroduction project to achieve the reintroduction population objective. Landowners of adjacent properties currently supporting occupancy by Mexican wolves could, under provisions of the 10(j) rule require the Service to remove those wolves at any time.
Response: It is useful biologically to discuss the entire Mexican wolf population, which includes those animals on FAIR and surrounding areas, and thus the conservation assessment continues to use the term "Blue Range population" in this context. "Blue Range population" is also an appropriate term to use in reference to data collected by the IFT, which typically includes wolves outside of the BRWRA in order to account for all wolves for which information is known. The conservation assessment does not alter the Final Rule or FEIS in any way, particularly in regards to the population objective established for the non-essential experimental population in the BRWRA.

Comment: Pages 20 and 43. The conservation assessment uses the term "public" in an overly general sense. For example, the assessment states that not all recommendations from the 5-Year Review were implemented as expected by interested parties. Instead, it should be noted that there are many divergent interested parties and that not all parties want the recommendations of the 5-Year Review to be implemented. Similarly, the document states that the public indicates that regulatory mechanisms are not fully supporting the Mexican wolf reintroduction. While some parties may desire changes to existing regulatory mechanisms, not all parties do.
Response: The text has been edited to communicate that these statements do not refer to the public as a whole.

Comment: The conservation assessment is inherently weak because it merely compiles existing information but does not make any recommendations or analyze new information to better assess the severity of extinction risk to the Mexican wolf. It is a non-regulatory document that justifies action but does not provide it.
Response: The Service concurs that the purpose of the conservation assessment is to compile existing data and technical information, and considers this a significant goal because the information can be used to support a variety of activities (e.g., recovery planning, Final Rule revision) and communication opportunities. The Service wanted to capture the concepts discussed by the 2003 recovery team but recognized that the team had not yet fully developed its recommendations. The Service will consider the information contained in the conservation assessment and may issue recommendations or workload tasks to address its findings. The Service acknowledges the frustration of those who view the conservation assessment as another example of inaction, but remains certain that the development of this document will increase the speed and decrease the workload associated with the agency's future endeavors.

Comment: The final conservation assessment should include up-to-date data.
Response: The final conservation assessment includes up-to-date data as available, as explained in the Disclaimer. The assessment does not, in all cases, reassess statistics

available from the 5-Year Review if the situation remains generally consistent with previous patterns, but in most of these cases does provide examples of 2003-2008 data for comparison.

Comment: The conservation assessment should discuss the need to better involve the local community in the reintroduction project and address the needs of the residents of the BRWRA.
Response: This issue (that is, social impacts of the wolf reintroduction) is beyond the scope of the conservation assessment, therefore no change to the text has been made. The Service continues to acknowledge and try to resolve conflicts between the reintroduction project and local communities, and welcomes continued and increased communication with the residents of the BRWRA regarding specific issues and measures to resolve them.

Comment: The conservation assessment uses the term "adaptive management" and gives the public perception that the Service practices the principles of adaptive management for reintroducing the wolf.
Response: The term "adaptive management" is not used in the conservation assessment except in the title of a group or document (e.g., AMOC).

FOREWORD
Comment: The conservation assessment credits the SWDPS recovery team with the concepts included in the document, but fails to provide some of the decisions, assessments, and key documents developed by the team.
Response: The Service acknowledges that some of the team's decisions, assessments, and key documents are not included in this report because either they had been developed by one portion of the team without approval of the entire team, were only in draft form, or had not been vetted fully with the Service to ensure adherence to policy. The conservation assessment captures the concepts discussed by the team to the extent that they are available in published, peer-reviewed literature or gray literature (e.g., agency reports). The Service has kept a complete administrative record of the team's activities for future reference.

Comment: Page 5. The conservation assessment states that its purpose is to "provide information relevant to the conservation and recovery of the gray wolf." The document is lacking in the scientific quality that is required under the Federal Data Quality Act. Scientific method is contingent upon the validity and reliability of the experiment. Validity requires internal and external validity; reliability requires repeatability of the experiment. The conservation assessment and its data are flawed on both accounts.
Response: The conservation assessment itself is not a scientific experiment, rather it is a compilation of readily available, published, and in most cases peer reviewed, literature relevant to Mexican wolves and gray wolves.

Comment: Page 5. The conservation assessment states that social and economic effects are equally important but beyond the scope of the document; to be an effective and realistic report, it is essential to include full disclosure of the real social and economic effects of the Mexican wolf program.
Response: The Service acknowledges that the Mexican wolf program has important social and economic effects. One of the reasons that the conservation assessment does not contain

recommendations for management is because the social and economic aspects of wolf reintroduction were not considered in the development of the document. However, the Service determined that compiling biological science relevant to the Mexican wolf was an important step in the conservation of the Mexican wolf and was a sufficient stand-alone goal.

Comment: I am not aware of any formal policy decision establishing a “regional program” for gray wolf recovery in the Southwest. The accepted process for establishing a recovery program is the development and approval of a recovery plan for the taxonomic entity being recovered.
Response: The commenter correctly states that a formal policy decision to establish a “southwestern gray wolf recovery program” has never been made. The conservation assessment explains, however, that gray wolf recovery programs have been initiated in several geographic areas in the United States, including the Mexican wolf program in the Southwest. However, as the conservation assessment also explains, Mexican wolves are not currently listed as a subspecies; rather, they are included in the 1978 range-wide gray wolf listing. Therefore, the conservation assessment describes the Mexican wolf program within the context of gray wolf recovery in the Southwest in order to adhere to the listed status of the gray wolf. The commenter also correctly states that typically a recovery plan is developed for the taxonomic entity being recovered. The Service is very interested in proceeding with recovery planning and is still working to finalize a revision of the 1982 Mexican Wolf Recovery Plan. The multiple attempts at finalizing the Recovery Plan serve as recognition of a recovery effort in the Southwest Region of the Service.

EXECUTIVE SUMMARY
Comment: Page 8. The last sentence under “factor (A)” seems to be too pessimistic in stating that future habitat availability may decrease over time, as it does not seem to consider the potential for future participation by the San Carlos Indian Tribe or Mexico.
Response: The Executive Summary language on page 8 is a summarized statement of the longer discussion provided in “factor (A)” in the body of the document. As the conservation assessment describes, it is difficult to assess future habitat availability for wolves in the Southwest without recovery criteria. Projections of regional population growth in both the United States and Mexico based on Carroll et al. 2005 suggest that habitat may become less suitable over time as human population increases in number and distribution; however, because the resolution of population data for Mexico in this modeling exercise was not equivalent to data for the United States, the conservation assessment does not summarize results for Mexico. Potential sites for Mexican wolf reintroduction in Mexico have, however, been added in “*Redundancy*”. While ecologically suitable habitat currently exists on San Carlos lands and may continue in the future, the San Carlos tribe is a sovereign nation that determines whether or not wolves inhabit their lands. Thus, this is another factor that makes it difficult to determine future habitat availability for wolves.

Comment: Page 8. The conservation assessment mentions that one of the fundamental ecological conditions necessary for wolf habitat is security from human-caused mortality, but then goes on to state in other areas of the document that some level of human-caused mortality can be experienced by an expanding wolf population. Is this consistent?

Response: Yes. Different wolf populations can sustain varying levels of human-caused mortality without experiencing a decrease in population growth depending on their reproductive rate and other biological attributes (see discussion under "factor (E)"). However, when human-caused mortality becomes excessive (i.e., leading or substantially contributing to a population decline), security from human-caused mortality becomes an ecological condition necessary for wolf habitat.

Comment: Page 9. We urge the Service to carefully evaluate any modification to the reintroduction project. For example, if expanding the boundaries of the BRWRA were the silver bullet to the project's success, it would seem as if the addition of FAIR would have spelled instant improvement; this does not seem to be the case. Has an evaluation been conducted to determine the extent to which the boundaries should be modified?
Response: The Service is currently evaluating potential modifications to the reintroduction project and the Final Rule, including those identified by the public scoping process in 2007. See the Service's Mexican wolf website for updates on progress on evaluation of modification of the Final Rule, at
http://www.fws.gov/southwest/es/mexicanwolf/rule_modification.shtml.

Comment: Page 9. It is misleading to state under "factor (C)" that only one wild wolf has died from disease when several other wolves died in captivity after exposure to disease in the wild. Further, given the loss of several animals and unmeasured potential for other pups to die from diseases undetected, it may be more accurate to say that this factor is not fully understood rather than that it is not a threat.
Response: The conservation assessment presents data in "factor (C)" as it is collected and characterized by the Service, therefore making the distinction between wolves that die in captivity and those that die in the wild. Even if captive and wild disease-related deaths are combined from 1998 to 2008 (3 parvovirus and 2 distemper), the number of known disease-related deaths occurring within this ten-year timeframe is small. Thus the conservation assessment can confidently state that threats to the current population from disease are well understood and considered to be insignificant. However, the conservation assessment acknowledges that the potential for disease outbreaks to increase in the future exists and that the potential exists for uncollared young pups to die from diseases undetected. A clarifying statement has been added to the discussion of "factor (C)" that disease could become a significant threat in the future.

Comment: Page 9, Factor E. The role of small litter size does not receive much discussion in the conservation assessment. Human-caused mortality has occurred in all wolf recovery efforts and yet recovery in other regions of the United States has progressed. We wonder if the conservation assessment's conclusion that the limited success of the Mexican wolf reintroduction is due to human-caused mortality is accurate and if other factors such as small litter size may play a major role in achieving the population target.
Response: As the conservation assessment states, actual litter size at birth in the Blue Range population is not known. Pup counts are conducted opportunistically after pups emerge from the den, and thus do not capture early pup mortality. Small litter size or low pup recruitment could explain observed numbers. However, small litter size has also been documented in the Blue Range population during genetic research on the effects of inbreeding, and discussion of

the results from this study (Fredrickson et al. 2007) have been expanded upon in the final conservation assessment. Without conducting a formal population viability analysis, which is outside the scope of this document, it is difficult to quantitatively determine the effect of small litter size on the growth rate of the Blue Range population, although the obvious and significant effect of small litter size is that it results in slow population growth. A sensitivity analysis could provide insight as to which of the population's vital rates (fecundity, survival) are most affecting its growth and thus what management actions could most rapidly lead to population growth. Text has been added to "factor (E)" to discuss the importance of the cumulative effects of identified threats and biological attributes (such as litter size) of the Blue Range population to address this comment.

Comment: Page 10. The conservation assessment states that wolf removals may function as the equivalent of wolf mortality if the wolf is permanently removed from the wild. In addition to "permanent removals" there are additional wolves that are *de facto* removed because they died during capture or have been placed in captivity and not yet returned to the wild.
Response: We agree that some wolves are *de facto* removed from the wild for these reasons and that if they were included in the removal data, the removal rate would be higher. The conservation assessment has added discussion of re-release candidates dying in captivity to "factor (B)". In some cases, re-release of captive wolves may take several years depending on factors such as pairing opportunities or appropriate release conditions.

Comment: Page 12. If the Service were serious about the genetic management of the wild population, it never would have promulgated SOP 13.
Response: The Service will make no further decisions that relate to the Mexican Wolf Recovery Program pursuant to SOP 13 as issued on April 30, 2005, or as altered by the Clarification Memo on May 28, 2009.

Comment: Page 12. The conclusion that the current reintroduced population is relatively secure from threats is not supported by the review of threats (d) and (e) on pages 9 and 10.
Response: The draft conservation assessment's conclusion that the Blue Range population is relatively secure from threats has been revised based on this comment, as it correctly points out that this conclusion was not supported by the material presented. In addition, summary statements have been added for each of the regulatory factors under "factor (D)" (rather than a collective summary statement), and several new items have been added to "factor (E)" (inbreeding, hybridization). To the extent possible, vague phrases such as "relatively secure" have been eliminated from the text.

HISTORY OF THE GRAY WOLF RECOVERY PROGRAM IN THE SOUTHWEST

The Decline of the Gray Wolf in the Southwestern United States

Comment: The Service characterizes gray wolf recovery as geographically-based despite the Service's binding 1978 commitment to conserve subspecies. Further, the conservation assessment provides an overly broad characterization of Mexican wolves as historically

inhabiting the southwestern United States and Mexico and obscures the special evolutionary connection between the Mexican wolf and the Sky Islands region of the United States.
Response: The conservation assessment explains that the Service's gray wolf recovery efforts have been regional, as opposed to national, in scope. However, the conservation assessment also explains that the Service's commitment to conserve valid subspecies resulted in a sustained conservation focus on the Mexican wolf in the southwestern United States. Thus, there have been geographic as well as subspecific elements to the Service's multiple gray wolf recovery programs. As explained in the "Foreword", the conservation assessment does use terms such as "southwestern" and "Southwest" broadly, but provides more specific geographic references when necessary. The conservation assessment states that the Mexican wolf was historically known from the southwestern United States and Mexico as a topic (i.e., general) sentence, which is then described in detail with the name of specific mountain ranges and other relevant topographic features. In order to strike a balance between accuracy and succinctness, details on the location of individual Mexican wolf specimens are not provided but can be found in the in-text citations provided.

Comment: The lack of a recovery goal for Mexican gray wolves should not preclude or delay immediate and ongoing management decisions and actions necessary to ensure the success of the BRWRA Mexican wolf reintroduction project and rapid achievement of its 100+ wolf objective.
Response: The conservation assessment does not state that achievement of existing objectives should be delayed until a recovery goal has been developed.

Comment: Page 16. The conservation assessment incorrectly states that McBride estimated 50 breeding pairs of wolves rather than 50 individual wolves.
Response: McBride (1980:3) states, "It is doubtful, though, that in 1978 more than 50 adult breeding pairs of wolves could be present in the entire Republic of Mexico."

Comment: Page 19: Replace the term "success" with "population dynamics" when comparing the Mexican wolf and red wolf programs.
Response: The conservation assessment uses the term "success" in reference to released wolves as it is defined by the 5-Year Review, i.e., a released wolf that breeds and produces pups in the wild (AMOC and IFT 2005: TC-5).

Comment: Captive wolves have problems adjusting to the wild; they are used to being fed by humans from vehicles and therefore associate humans with food, are commonly hit by vehicles, are not experienced killing prey.
Response: Appropriate management procedures continue to be conducted in captive and pre-release facilities to minimize habituation to humans. Data does suggest that wolves are more successful producing and raising pups the longer they are in the wild, demonstrating that captive wolves adjust to the wild and contribute to the population. Although many of the wolf-human interactions that have occurred in the Blue Range (as documented in the 5-Year Review) were by wolves recently released from captivity, the number of these events in the 11 years of the reintroduction is relatively small overall and as compared to the number of initial-release wolves.

The Road to Recovery for the Gray Wolf
Comment: All of the useful information in the conservation assessment should have been in a revised recovery plan instead. The conservation assessment minimizes the policy-driven failure to reconvene the former recovery team.
Response: The intent of the conservation assessment is to provide information that can be incorporated as appropriate to a revised recovery plan to expedite the recovery planning effort. The text has been updated to reflect recent reclassification and delisting actions taken by the Service for the gray wolf in the Northern Rockies and Great Lakes. The text has also been modified in response to this comment to objectively describe the current status of recovery planning for the Mexican wolf in the Southwest.

Comment: The description of the 3-Year Review should mention the caveat that the authors were forced to speculate on key issues due to scant data. The authors of the 3-Year Review admitted that their report is only as good as the information it is based on.
Response: The document has been modified to incorporate this recommendation.

Comment: Page 19. It is incorrect and dishonest to state that the population has "grown steadily" since 1998. It grew steadily from 1998 to 2003, but has since declined overall despite continued releases from the captive population, with four out of five years showing a decline or stagnation.
Response: The conservation assessment used the words "grew steadily" in the most general sense to explain that the population had expanded from the original release of 11 wolves in 1998 to its current size. However, this generalization is so coarse as to appear incorrect at worst, and at best fails to provide an informative description of the population's trajectory. The text has been revised to provide more information on the growth of the population, and a table (Table 1) documenting the minimum annual population count and number of breeding pairs has been added.

Comment: Page 19. The 2006 and 2007 population counts are flawed because they use a definition of "breeding pair" which is inconsistent with the definition set forth in the Final Rule; neither the Service nor AMOC have the authority to change portions of the Final Rule without complying with procedural and substantive rulemaking requirements. Breeding pairs that do not meet the legal definition should be subtracted from the count in this document and others, and the Service should use the legally binding definition of breeding pair from now on.
Response: The draft conservation assessment utilizes the reintroduction project's official published end-of-year population counts, which include the number of breeding pairs in the population. In response to this comment, the text has been modified to provide the definition of breeding pair as it is defined in the Final Rule and as it is interpreted by the Service and AMOC/IFT.

Comment: Page 19-20. The Service's myth that "naïve" wolves may slow reintroduction success is based on a misleading analysis in the 5-Year Review. [The commenter provides a detailed description of the analytical methodology used in the 5-Year Review to estimate success of Mexican wolves in the wild, identifying individual data points (wolves) that

confound the analysis, and provides suggestions for more effective methodologies and metrics.]
Response: The potential for naïve wolves to slow the success of the reintroduction project was identified several years prior to the 5-Year Review, as referenced with the in-text citations of Brown and Parsons 2001 and Brown 1983. The text in this section has been modified because it was somewhat redundant with information contained in the "Threats Assessment", and the hypotheses for the project's progress have been removed. The issue of naïve wolves providing a challenge to the reintroduction is now presented based on a published paper (Brown and Parsons 2001) that described the first two years of the reintroduction. The commenter's suggestions relating to analysis of "success" are under consideration by the Service for future use.

Comment: Page 20. The socioeconomic components of the 3- and 5-Year Reviews were highly flawed and generated extensive critical comments. There is no useful purpose in referring to them.
Response: The conservation assessment mentioned these components to document their existence, without validating their quality. However, the commenter has a valid point that referencing these documents serves no useful purpose because the conservation assessment focuses on biological, rather than socioeconomic, information; the conservation assessment now refers only to the biological components of both reviews.

Comment: Page 20. The conservation assessment should go into more detail about why recommendations from the 3-Year Review were not implemented.
Response: Reasons for lack of or delayed implementation of 3-Year Review recommendations is provided in detail in the Administrative Component of the 5-Year Review. It is not clear from the commenter's request what benefit this information would have for the conservation assessment. The conservation assessment strives to strike a balance between providing enough information to accurately depict the history and current status of the reintroduction project without including information readily available elsewhere that does not substantively contribute to the assessment.

Comment: Page 20. The description of the 3-Year Review should include the recommendation by Paquet et al. that livestock operators on public land take responsibility for carcass management/disposal.
Response: This recommendation from page 67 of the 3-Year Review is already mentioned in "factor (D)".

Comment: It should be mentioned that the conclusions of the 3-Year Review were made before SOP 13 was implemented.
Response: No change has been made in response to this comment, as the chronology of the 3-Year Review and SOP 13 are made obvious by their dates.

Comment: Page 20. I am aware of no hard evidence that the Service or its partners sought to implement recommendations from the 3-Year Review.
Response: In response to this comment, the reference to implementation of the recommendations from the 3-Year Review has been removed, as it did not add to the

substance of the conservation assessment. However, as an example of an effort to implement recommendations from the 3-Year Review, the Service convened a recovery team to revise the 1982 Mexican Wolf Recovery Plan in 2003.

Comment: Page 21. The conservation assessment incorrectly states that the 5-Year Review incorporated extensive public input. Public input was solicited, but very little of that input was incorporated in the final 5-Year Review.
Response: This text has been deleted, as it does not add substantively to the conservation assessment.

Comment: Page 21. The summary statement, "Progress in achieving the Mexican wolf population target of at least 100 wolves in the BRWRA has fallen short of initial expectations by several years, likely due to a combination of biological and regulatory factors" should be modified to "due to management factors". The reference to biological factors is without support, and "regulatory" is misleading in that it conflates true regulatory factors such as the requirement in the final rule to recapture wolves who establish territories wholly outside the BRWRA with what are discretionary management policies, e.g., SOP 13. In recent years, the period of population stagnation and decline, the primary cause of permanent removals has been SOP 13, not boundary infractions that do not require permanent removal.
Response: This summary statement has been removed due to corresponding changes to the text preceding it. The discussion of reasons for the reintroduction project was redundant to information contained in the "Threats Assessment". This section of text now describes the reviews of the project that have been conducted, including the recommendations offered by each. In response to this comment, which accurately depicted the important difference between regulatory and discretionary management activities, the term "management" has been added to the discussion of the adequacy of regulatory factors in "factor (D)", and the conservation assessment distinguishes between the two.

Comment: The Mexican wolf reintroduction must be based on sound science. Until data gaps identified in the 5-Year Review and elsewhere are filled, the project should not be modified or expanded.
Response: This comment is not incorporated into the conservation assessment, as the assessment does not contain recommendations or prioritized conservation actions for the Mexican wolf program or reintroduction project. The intent of this document is to synthesize available science relative to the reintroduction and recovery effort.

Comment: The conservation assessment falsely claims that the prime objective of the 1982 Mexican Wolf Recovery Plan to establish a population of 100 wild wolves was not considered sufficient to serve as recovery criteria when the plan was written. As agency personnel fail to implement the existing plan, the 1982 population target has been arbitrarily considered insufficient. The population target of 100 should be considered the recovery goal since there is not scientific confirmation that wolves existed in large number in the Southwest historically. The population target of 100 would be a feasible goal given the complex social and environmental conditions in the Southwest.
Response: The 1982 Mexican Wolf Recovery Plan plainly states that at the time of writing, the recovery team did not think the Mexican wolf could be recovered sufficiently for

delisting and that the prime objective was intended to ensure the survival of the Mexican wolf (USFWS 1982: 23). The Service continues to acknowledge the need to develop objective and measurable recovery criteria in a revised recovery plan.

Comment: Mexican wolf conservation and reintroduction should be a collaborative effort between the United States and Mexico. The Mexican government's formal designation of the Mexican wolf as an endangered subspecies adds increased importance to the Service's fulfilling its commitment to conserve the Mexican wolf.
Response: As the conservation assessment describes, the United States and Mexico have taken a collaborative approach to elements of Mexican wolf conservation, including participation in recovery planning and the establishment of a binational network of captive breeding facilities. However, Mexican wolf conservation in each country is pursued based on each country's relevant statutes, which result in different goals and approaches to conservation, particularly in regard to reintroduction. To date, reintroduction plans have not been coordinated between the two countries, but this does not preclude such effort in the future if geographic considerations warrant such coordination (e.g., reintroduction in the borderlands).

Comment: The conservation assessment fails to provide information on reintroduction or recovery efforts in Mexico.
Response: The conservation assessment now states that wolves have not yet been reintroduced to Mexico, and provides results from habitat modeling for potential reintroduction sites. Contact with Mexican officials was attempted but unsuccessful, and additional information, in English, was not readily available.

Comment: Page 28. The conservation assessment repeats the three hypotheses in the 5-Year Review on why litter sizes have been so low in the Blue Range population. There is little support for any of these hypotheses. The following information should be considered for Hypothesis 1: 1) wolves' litter sizes in the Blue Range population show substantial variation in litter size among packs, with genetic analyses (Fredrickson et al. 2007) showing that packs in which one or both alphas are F1 or cross-lineage wolves averaged 51 percent larger litters than packs in which both alphas were pure McBride wolves. Further, this analysis demonstrated that this variation was in large part due to variation in inbreeding level of the pups, which in Mexican wolves is related to inbreeding levels of the parents. 2) Hypothesis 1 is inconsistent with the litter sizes observed among historic wild wolves in Mexico by McBride (1980) – areas that likely received less snow than the Blue Range Wolf Recovery Area. The following information should be considered for Hypothesis 2: 1) This is historical conjecture with no support from historical observations of McBride (1980) or the Blue Range population. The most successful Blue Range populations (Bluestem M507 x F521, Aspen M512 x F667) have produced pups with low inbreeding coefficients and had large litter sizes relative to the mean. 2) Hypothesis 2 makes no historical sense – how would having small litters, relative to outbred Mexican wolves and other gray wolf subspecies, serve to increase fitness? Prey is not limiting in the Blue Range. Even populations of northern gray wolves thought to be at carrying capacity with comparatively poor prey resources have larger litters than the low-density, prey-rich BRWRA. The following information should be considered for Hypothesis 3: 1) Data from the Blue Range population does not support that wolves from

captivity are less capable of exploiting vulnerable prey; for example, all four alphas in the Bluestem and Aspen packs (the most successful packs in recent times in terms of recruiting yearlings or new alphas) were born and raised in captivity. 2) Studies from inbred Scandinavian wolf populations have found that within an inbreeding level, those that recruit to alpha status tend to be those with the greatest heterozygosity, that is, those with the greatest fitness also tend to be those with the greatest heterozygosity (Bensch et al. 2006).
Response: The conservation assessment cannot change the hypotheses or supporting information presented in the 5-Year Review, and considers it important to document the hypotheses presented by the agencies managing the reintroduction. Inbreeding has been added as a explanation of small litter size, based on Fredrickson et al. 2007. The text has been modified to state that conclusive data or information supporting or refuting the hypotheses presented in the 5-Year Review is not available.

Status and Implications of National Gray Wolf Recovery for the Mexican Wolf
Comment: Pages 3, 23, 43, 45. The Service should not use litigation as an excuse for having put the 2003 recovery team on hold. Neither the Defenders of Wildlife v. Norton, 03-1348-JO nor the National Wildlife Federation v. Norton, 1:03-CV-340, D. VT. 2005 cases contained provisions that forced suspension of the recovery team. The result of both cases was to revert to the 1978 listing rule, under which the original 1982 Mexican Wolf Recovery Plan was written.
Response: The Service agrees that neither case forced the agency to put the recovery team on hold and that the team could have moved forward with a revised Mexican wolf recovery plan under the auspices of the 1978 listing. However, as explained in "Status and Implications of National Gray Wolf Recovery on the Southwest", the Service made a policy decision to put the recovery team on hold because the agency was initially unsure of how it would respond to the litigation. That is, the agency was unsure whether, where, and when it would redesignate multiple gray wolf DPSs that would supercede the 1978 listing rule. Designation of a different southwestern DPS could have affected the geographic mandate of the recovery team and had implications for development of recovery criteria. In response to this comment, the text has been revised to explain that given the Service's decision to redesignate DPSs only in the Northern Rockies and Great Lakes, the Southwest remains governed by the 1978 listing rule and is currently in a position to return to recovery planning.

Comment: Revise the 1982 Mexican Wolf Recovery Plan.
Response: This recommendation is under consideration by the Service. No change has been made to the text of the conservation assessment, as the document does not contain strategic or policy-related recommendations.

Comment: Page 22. Unlike gray wolves in other parts of the United States, the Mexican gray wolves in the United States have no source population in the wild with which to maintain connectivity. This is a critically important factor for recovery that the conservation assessment fails to mention.
Response: The conservation assessment intended for this fact to be clear but failed to explicitly state that a source population of wild Mexican wolves does not exist in the Southwest or Mexico. This information is a critical consideration in the conservation and

recovery of the Mexican wolf, and an explicit statement has been added in “The Establishment of the Mexican Wolf Recovery Program” in response to this comment.

Comment: In the discussion of the recovery progress of the Great Lakes and Northern Rockies gray wolf recovery programs, the conservation assessment fails to mention the difference in land mass between these areas and the BRWRA, and the differences in land management; i.e., there is much more “protected” land in the Northern Rockies.
Response: There are a number of differences between the programs that may have affected the progress achieved in each of the Service’s gray wolf recovery programs, certainly including those mentioned by the commenter. The conservation assessment is not attempting to characterize why gray wolves recovered more quickly in these areas, but instead to provide a big-picture snapshot of gray wolf recovery nationwide and to state the implications related to delisting of the Great Lakes and Northern Rockies for the Southwest. In response to this comment, a statement that the programs differed in features such as land status has been added to this section.

State and International Regulatory Protection in the Southwestern United States and Mexico
Comment: The listed status of the wolf in Arizona needs to be updated.
Response: The text has been modified in response to this comment.

GRAY WOLF BIOLOGY AND ECOLOGY
Comment: Because Mexican wolves are from a captive population, it may be more useful to compare them to red wolves than other populations of gray wolves.
Response: We agree that comparison to red wolves is informative and have included such information where useful in this section; we also note that comparison between the Mexican wolf and red wolf is available in the 5-Year Review. However, because the Mexican wolf is a subspecies of gray wolf and is listed under the range-wide gray wolf listing of 1978, comparison to other gray wolf populations provides a benchmark for assessing the current status of the Mexican wolf reintroduction within the context of conservation and recovery of the listed entity.

Taxonomy and Range
Comment: Page 26. I question the conservation assessment’s interpretation of Leonard et al. (2005) that there is evidence of some historical contact between Mexican wolves and northern subspecies. Successive north to south and south to north radiations during successive ice ages could easily explain how “southern gray wolves” could retain some “northern” genetic markers and how gray wolves in mid-latitudes of the coterminous United States could retain some “southern” markers without direct historical contact. Alternatively, transport of a gene could occur from successive reproductive events, i.e., a Mexican wolf disperses 200 miles northward, successfully breeds with a mate from that northerly region, and offspring from that reproductive event could then disperse another 200 miles northward and successfully mate with a wolf from that region, moving a Mexican wolf genetic marker even further north. Thus, the presence of a genetic marker for a particular subspecies of gray wolf in a specific location does not imply with any certainty that the original source animal for that maker actually occupied that geographic location.

Response: The text has been modified to more clearly describe the results of the research so as not to affirm direct contact between Mexican and northern wolves.

Comment: Page 27. Mexican wolf mitochondrial DNA (which does not code for genetic traits) differs from mtDNA of other subspecies by 2.2 percent. That is, the Mexican wolf's genetic attributes do not differ 2.2 percent from other wolves; this percentage is misleading and should be removed.
Response: As identified by this comment, the 2.2 percent difference is based only on mitochondrial DNA data. The data on the genetic distinctiveness of Mexican wolves is not solely from mitochondrial DNA, but includes information from other genetic markers (microsatellite DNA). Reference to the 2.2 percent figure has therefore been replaced with a more general and inclusive statement of the genetic attributes of Mexican wolves.

Comment: The conservation assessment states that the intergradation of haplotypes has been conceptualized as a southern clade. This is incorrect; it is the set of four mtDNA haplotypes that cluster together in a phylogenetic tree that have been conceptualized as a southern clade. The assessment's interpretation that historical contact, i.e., breeding occurred between Canadian wolves and Mexican wolves is not supported by Leonard et al. 2005.
Response: The description of the southern clade has been corrected in response to this comment. The text has also been modified to more clearly describe the results of Leonard et al. 2005 so as not to affirm direct contact occurred between Mexican and northern wolves.

Physical Description and Life History

Comment: Page 28. The litter size of cross-lineage wolves in the reintroduced population is much larger than the litter size of McBride wolves. This effect may be due to inbreeding rather than ecological factors. Add inbreeding to the list of hypotheses for reduced litter sizes, based on the results of Fredrickson et al. 2007
Response: Inbreeding depression was added to the list of hypotheses regarding litter size of Mexican wolves. Discussion of the affect of inbreeding on litter size has also been added to "factor (E)".

Comment: Page 28. The number of pups born in the wild and their survival rate is a critical data gap that needs to be filled.
Response: This recommendation is under consideration by the Service. The need for improved, statistically reliable population survey and monitoring techniques was identified by AMOC in the 5-Year Review (AMOC and IFT 2005: ARC-6). No change has been made to the text of the conservation assessment, as the document does not contain recommendations.

Comment: Page 32. Assuming the statistic that there is one wolf removal per 1.67 confirmed depredations is correct, this is a clear explanation of why the population objective has not being met and is a damning indictment of current management procedures.
Response: This statistic has been updated with data from 2008. The conservation assessment clearly states that livestock removal is the leading cause of management removal of a wolf from the Blue Range population.

Comment: Page 34. Humans have been a significant source of mortality and at a rate above that expected relative to Mexican wolf recovery.
Response: The conservation assessment states that vehicle collision and illegal shooting are the two biggest sources of mortality of reintroduced Mexican wolves, and provides detailed discussion of each, respectively, under "factor (A) and "factor (E)". The commenter does not provide a source for the reference to "that expected relative to Mexican wolf recovery", therefore it is difficult to either support or refute whether or not current rates are above or below what was "expected".

Pack Formations and Movements
No comments received on this section.

Ecology and Habitat Description
Comment: Wolves in the BRWRA have been staying at higher elevations than expected. Provide hypotheses as to why this is occurring.
Response: The commenter did not provide data to substantiate this statement, nor is elevation data provided in annual reports or other project documentation. Therefore, no change to the text has been made.

Comment: The conservation assessment incorrectly claims that Mexican wolves were historically associated with montane woodlands at elevations of 4000-5000 ft. This statement is based on post-1900's observations of wolves that were likely attracted to cattle herds. Literature suggests that the Mexican wolf was a desert and low elevation wolf that occurred in south Texas and similar areas in southern areas in AZ and NM, and is likely better suited to drier desert habitat than the montane regions it is currently being artificially forced to occupy. The wolves that occurred in mountainous regions were more likely *Canis lupus mogollonesis*.
Response: In "Decline of the Gray Wolf in the Southwestern United States", the conservation assessment references two reputable sources, Young and Goldman (1944) and Brown (1983) to describe the historic range of the Mexican wolf and other gray wolves in the Southwest, acknowledging that historic gray wolf abundance and distribution in the Southwest is confounded by both lack of data as well as changing gray wolf taxonomy. A detailed discussion of this topic is provided in "Taxonomy and Range." Wolves in the BRWRA are successfully hunting and killing prey (primarily elk), providing no indication that they are having difficulty exploiting the prey found at the more northern latitudes and elevations of the reintroduction area (see "Ecology and Habitat Description").

Comment: There is strong evidence that Mexican wolves are food limited in the BRWRA; cattle, horses, and dogs are providing a food source for Mexican wolves.
Response: Studies of the diet of Mexican wolves in the BRWRA have determined that elk are the primary food source for wolves (Reed et al. 2006). The Service acknowledges that wolves have killed cattle, horses, and dogs. However, these depredation incidents are not the wolves' primary food source.

Wolves and Non-prey

No comments received on this section.

Wolf-Human Interactions
No comments received on this section.

CONSERVATION ASSESSMENT
Threats to the Gray Wolf in the Southwest

Factor A
Comment: The BRWRA has more human inhabitants than acknowledged in the FEIS and Final Rule. Every wolf release has been within 10 miles of a home or town. More homes are being built as agricultural businesses disappear.
Response: The commenter does not provide any data or references to refute the information provided in the FEIS or Final Rule. Conflicts between wolves and some members of the communities in the BRWRA have certainly occurred, as the development and implementation of SOP 13 makes clear. Discussion of projections of increasing human population and resultant development in "factor (A)" generally address and support the commenter's observation about the loss of agricultural lands, thus no change to the document has been made.

Comment: Page 37-38. Vehicular-caused mortalities may not be significant as a single cause, but when combined with other unnatural mortality factors, it appears that there is a problem. Even small mortality rates can be significant in such a small population.
Response: The draft conservation assessment failed to discuss the cumulative impacts of multiple threats, and the text has been modified to address this issue.

Comment: Page 37. Several scientific articles have refuted the Thiel reference, see pp. 301-302 in "Wolves" 2003.
Response: The text has been modified to acknowledge that research of wolf populations more recent than the Thiel (1985) reference has documented wolves persisting in areas with higher road density than that recommended by Thiel.

Comment: Page 37. In a possible attempt to be succinct, the conservation assessment inadvertently understates the ability of the BRWRA and FAIR to support wolves; use the numbers provided in the Paquet Report (Paquet et al. 2001:47).
Response: The text has been edited to provide the estimate given by Paquet et al. 2001.

Comment: The conservation assessment should consider tribal lands and Mexico in the habitat discussion in "factor (A)".
Response: Habitat suitability in Mexico does not affect the Blue Range population at the current time or the BRWRA population target of at least 100 wolves. Future modifications to the geographic boundaries (and associated regulations) of the MWEPA or the implementation of a new reintroduction project in the United States could result in the possibility wolf movements from the United States into Mexico, in which case habitat suitability in Mexico would be pertinent to the Service's recovery efforts. However, until recovery criteria are developed in a revised recovery plan, it is very difficult to assess

whether or to what degree the Service's recovery efforts would rely on wolf abundance and distribution in Mexico. The data used in the modeling scenarios performed by Carroll et al. (2005) for Mexico were very course in scale, particularly so for road data, precluding any meaningful discussion of results beyond the trends discussed for the United States of increasing road density leading to increasingly unsuitable wolf habitat. For tribal lands, planning and development information is not readily accessible; further, tribes are sovereign nations that may participate in wolf reintroduction if and as so they choose. Therefore, it is difficult to provide insight into future tribal decisions concerning the use of their lands by wolves.

Comment: The tone of the document exaggerates uncertainty related to prey distribution (page 37) and population viability, and results in casting uncertainty on these methods and the scientific basis for managing populations.
Response: The conservation assessment strives to articulate areas of uncertainty or inadequate information, but does not intend for this information to be confusing or cast doubt on scientific methods for managing populations. In response to this comment, the text has been modified to provide a clearer depiction of what is known about prey distribution and a summary paragraph has been added to the discussion of resiliency to provide clarity on application of the information for the Mexican wolf.

Comment: The BRWRA has insufficient prey numbers; prey was underestimated in the EIS and Final Rule. Wolves are competing with other predators, which were also underestimated, further depleting prey numbers.
Response: The commenter does not provide data or references that can be added to the conservation assessment's discussion of prey availability in the BRWRA or wolf interactions with other predators; therefore, no change has been made to the document.

Comment: Fires were not listed as a significant issue. As trees continue to become thick and unhealthy, fires will increase in numbers and severity. Increased tree density means less forage and water available for predator and prey.
Response: The Forest Service incorporates both human safety and ecological considerations into its fire management regime for the Gila and Apache National Forests. The commenter did not provide any data or references that tree density is currently affecting prey availability for wolves in the BRWRA; therefore, no change to the text has been made.

Factor B
Comment: Did FWS provide surplus captive wolves to USDA-APHIS for rabies or parvo-vaccine testing that involved lethal technique?
Response: No. The Service is participating in the first stage of a USDA-WS rabies efficacy study in which blood and data are collected from the Mexican wolf captive population to analyze titers being produced by the vaccine. This stage of the study does not involve lethal technique; that is, participation in this phase of the study does not result in Mexican wolf mortality.

Comment: Page 39-40. We believe that the Service's claim that only two wild and one captive pre-release capture-related deaths have occurred is a gross understatement of the

casualties of capture. A total of 13 wolves died either during or within a few weeks of capture, including 6 pups killed by a surrogate father, and one wolf (M1018) that was found dead in his pen less than a week following capture in 2006. Although a necropsy was officially indeterminate as to cause, the death of M1018 fits the general rule that a death soon after capture is likely to be capture-related.
Response: The text has been modified to include discussion of eight wolves that would have been rerelease candidates had they not died while in captivity, as it could be argued that the loss of these wolves directly affected the Blue Range population. The death of permanently removed wolves, included in the commenter's tally, is not discussed, as they no longer had an opportunity to contribute to the Blue Range population. The Service acknowledges that the unintended death of a wolf due to capture activities or circumstances in captivity is tragic, and all precautions are taken to avoid such situations. However, it is the Service's opinion that capture and handling of wolves is a necessary element of the project in order to provide vaccinations and medical treatment, translocate wolves, and respond to issues concerning livestock, nuisance, or boundary-violations. Further, it is the Service's opinion that unintended deaths have been rare.

Factor C
Comment: Page 41. Canine parvovirus is thought to have been the cause of low pup survival in Yellowstone National Park during 2 summers, see Smith and Almberg 2007 Yellowstone Science Vol. 15:17-19.
Response: This information has been incorporated.

Comment: A rabies outbreak is currently occurring in an area where a pack of wolves (Luna Pack) has disappeared. Because the wolves were uncollared, the Service discounts that they may have died from rabies. It seems unlikely that wolves have not been impacted by distemper, parvo, or rabies, when dogs in the area have been lost due to these diseases.
Response: As the conservation assessment states, disease has not been a significant source of mortality of collared wolves (one out of 68 deaths) from 1998 to June 1, 2009. It is possible that uncollared wolves have died from diseases and therefore have not been documented. The conservation assessment simply reports on data collected to date rather than speculate on possible mortality factors for specific individuals.

Comment: Insect infestations, like mange, are a significant health problem. (66)
Response: Mange can be a significant health problem in wolf populations. However, the commenter does not provide any data for the Blue Range population to support the statement, and there is no indication from available monitoring of mange presenting a serious health problem.

Factor D
Comment: The Columbia Basin pygmy rabbits provide a recent sad example of the combination of prolonged management failure leading not just to extirpation in the wild but also to the closing of captive breeding as a rescue option.
Response: The Service and its partners are strongly committed to the BRWRA reintroduction project and the Mexican wolf recovery program.

Comment: Page 43. The conservation assessment summarizes the justification provided in the 5-Year Review for why the internal boundaries of the BRWRA had not yet been modified by 2005. Defensive rationalization does not contribute to recovery, moreover, it concedes that the Service has wasted years vacillating between rule-making and recovery planning and ultimately accomplishing neither.
Response: The conservation assessment strives to provide enough information that the reader does not need to refer to cited documents in order to understand the current status of the Mexican wolf, while not providing details that are not germane to the present situation. Whether or not the justifications provided in the 5-Year Review or the conservation assessment are satisfactory to the commenter, the commenter is correct in stating that the Service has not accomplished a rule change or a revised recovery plan.

Comment: Livestock carcass removal is difficult due to remoteness and lack of vehicular access; disposal usually consists of mechanical removal or burial, burning, liming, and tapping, which in some instances is illegal.
Response: The Service and its partners acknowledge the difficulty of removing livestock carcasses.

Comment: Page 44. The conservation assessment describes the outcome of the 5-Year Review carcass feeding issue, i.e., that the sample size was too small to determine whether a depredation predisposition exists and that Federal and State agencies do not have the authority to require lease and permit holders to remove carcasses from public land. Both of these claims were refuted in critiques of the 5-Year Review (the 5-Year Review that did not include livestock necropsy results, was based on limited monitoring of wolves, failed to document all instances of wolves feeding on livestock, and failed to consider or present the chronology of depredation/scavenging incidents in its results), requests for additional legal opinions on Federal and State authority were not provided. Livestock carcasses are a major cause of depredations and must be removed to prevent conflict. The Forest Service and BLM should require permittees on public land to monitor their stock and remove dead animals promptly. Alternatively, the Fish and Wildlife Service could by regulation or protocol exempt wolves exposed to livestock carcasses that they did not kill from future control actions. The conservation assessment both underestimates the impacts of making cattle and horse carcasses available to wolves as well as failing to identify the level of predator control that can be sustained by the wolf population while still meeting reintroduction project goals.
Response: As the conservation assessment states, the Forest Service and BLM do not presently have the authority to require lease and permit holders to remove carcasses from public land. Following the lead agencies' determination in the 5-Year Review that insufficient data exist to determine whether a depredation predisposition exists, AMOC has committed to the development of an incentives program that will address this and other depredation issues. Furthermore, the Fish and Wildlife Service has recently established a Mexican Wolf Interdiction Program with the goal of preventing or mitigating wolf depredation and nuisance impacts on local stakeholders through voluntary interdiction, incentive, and compensation programs. Funds are to be administered through the National Fish and Wildlife Foundation, with guidelines for the program to be established based on a consensus of participating ranchers, sportspeople, environmental interest group representatives, and local community members, with oversight by the Fish and Wildlife

Service. In addition to providing funds for livestock losses due to wolf depredations, the Interdiction Program will support proactive on-the-ground practices that reduce the potential for depredations, thus simultaneously supporting landscape conservation and improved land use practices in the Southwest. In response to this comment, a sentence has been added to explain that monitoring efforts may not detect all scavenging or predation events. The response of AMOC to comments received on the draft 5-Year Review is outside the purview of the conservation assessment.

Comment: Information on how the Forest Service is meeting the ESA's 7(a)(1) commitment to the Mexican wolf program should be included in the assessment of "factor (D)".
Response: Examples of some of the Forest Service's 7(a)(1) actions have been added to the conservation assessment.

Comment: The analysis of "factor (D)" should not just be limited to those raised by the 3-Year Review, 5-Year Review, USFWS/AMOC documents, and litigation. Other factors that should be included are: lack of explicit attention to genetic management, failure to make policy adjustments in a timely manner, and lack of leadership by the Service.
Response: "Factor (d)" initially contained only issues that had been raised by existing reviews, documents and litigation; while this approach did not identify new issues for analysis, it served the benefit of summarizing previously identified issues in one current document for an inclusive look at known or potential threats to the Mexican wolf. As several reviewers pointed out, there may be issues of increasing importance that have surfaced in the several years since the 5-Year Review (the most recent analysis of the reintroduction project) and these warrant identification and assessment. Of the three issues raised here – genetic management, policy adjustments, and leadership, the issue of genetic management is addressed in the new discussion of inbreeding as a threat under "factor (e)", and summary statements throughout "factor (D)" clearly state whether management action such as policy adjustment has been taken. The conservation assessment does not contain recommendations for management action.

Comment: Page 48. The combined mortality/removal rate is misleading. The additions to the population should be included or at least mentioned to provide an accurate understanding of losses and gains to the population.
Response: The Blue Range population has been augmented by the initial release of wolves from captivity during most years. In recent years, however, there have been few releases (e.g., two initial releases between 2005 and 2008, see USFWS 2009: Population Statistics); therefore, these gains to the population do not substantially alter population dynamics. In the initial years of the project, substantial numbers of initial releases were made; the text has been modified in response to this comment to acknowledge the effect these releases had on the population.

Comment: The conservation assessment minimizes the influence of SOP 13 in preventing progress toward the reintroduction objective.
Response: The conservation assessment states that livestock depredation has been the leading cause of wolf removals in the BRWRA and that the number of removals was the highest during several of the years in which SOP 13 was actively being implemented. The

assessment of regulatory mechanisms under "factor (D)" has been modified to provide summary statements specific to each issue to more clearly characterize the importance of each. Further, updates have been made to address the fact that SOP 13 is no longer in effect, per the settlement agreement reached with plaintiffs in Defenders, et al. v. U.S. Fish and Wildlife Service, et al., 08-cv-280 (D. Ariz.).

Comment: The statement on page 46, "Current interpretation and implementation of several regulatory mechanisms are not adequately supporting the reintroduction and recovery effort" appears to be in conflict with the discussion on page 44 that states there are inconclusive results as to whether a depredation predisposition exists. Currently there is no scientific information to conclude that regulatory mechanisms or management procedures for livestock are inadequate to support the recovery program. We suggest the summary statement address each regulatory mechanism (all 6 listed on page 43) and validate whether the statement is supported by existing information.
Response: We agree that this summary statement was overly broad and have edited the document to provide a summary statement for each regulatory mechanism.

Factor E
Comment: The conservation assessment does not acknowledge [in Factor E, Threats Assessment] that there is a middle ground of those who are not particularly pro or con wolf.
Response: The text has been modified to more fully describe public opinion of the Mexican wolf reintroduction.

Comment: Wolves are causing significant threats to humans leading to the large number of wolf deaths caused by shootings.
Response: A significant number of illegal wolf shootings have occurred in the Blue Range population, and although these shootings are likely attributable to dislike of wolves, there is no indication that they were caused specifically due to people feeling threatened at the time the shooting occurred. As established by the Final Rule, a person may take a wolf in self-defense (17.84(k)(3)(xii). Since the reintroduction began, one legal public shooting has been documented (USFWS 2009: Population Statistics).

Comment: Regulatory factors are responsible for the reintroduction project's failure to reach demographic goals. The Service should assess its own predator control program on the Mexican wolf instead of concluding that poaching is responsible for the population's stagnation; management actions have resulted in the death of 29 wolves, the re-release of wolves to the wild under unsuitable conditions, the permanent confinement of dozens of wolves to captivity, and the removal of genetically important wolves from the wild.
Response: Factors (B), (D), (E) assess the impact of management and regulatory impacts to the population. Illegal shooting is identified as a threat to the population, but not the sole reason for the population's current status. A discussion of cumulative threats has been added to "factor (E)".

Comment: The Service would rather blame illegal shooting of wolves as the reason for not reaching the population target of 100 wolves than address disease, genetic, and breeding issues.

Response: The conservation assessment does not state that illegal shooting of wolves is the sole reason for the project's delayed progress in reaching its population target. Rather, the conservation assessment finds that illegal shooting of wolves is one of several significant factors, also including regulatory factors and inbreeding. In response to this comment, a discussion of cumulative threats has been added to "factor (E)".

Comment: Page 47. No evidence has been provided by the assessment that the (in)adequacy of the Defenders of Wildlife compensation program leads to the illegal killing of wolves.
Response: The draft conservation assessment did not state that the Defenders compensation program *leads* to the illegal killing of wolves, nor in any way was this intended. Rather, it stated that the illegal killing of wolves continues *despite* the efforts of AMOC and Defenders to address wolf-related conflicts. The text intended to communicate that all combined outreach, education, and compensation efforts targeted at any and all factions of society were unsuccessful in curtailing illegal shooting. The text in the analysis of "factor (E)" has been revised sufficiently such that this unintended implication should no longer exist.

Comment: The conservation assessment states that illegal shooting occurs by those opposed to wolf reintroduction. This is a highly inflammatory statement. The document also states that AMOC's education and outreach efforts and Defenders of Wildlife's depredation compensation program have not been sufficient to alleviate some negative attitudes toward wolves, as evidenced by continued shooting of wolves – this insinuates that primarily ranchers are shooting wolves.
Response: The draft conservation assessment did not intend to be inflammatory, and realizes that the introduction to "factor (E)" was poorly worded in such a way as to potentially insinuate that ranchers are shooting wolves. The draft conservation assessment intended to communicate that all combined outreach, education, and compensation efforts have been unsuccessful in curtailing illegal shooting by any of the responsible parties. The discussion of illegal shooting has been modified to address this comment.

Comment: Mexican wolves and coyotes look very similar; mistaken identity should be mentioned as a reason for illegal shooting of wolves.
Response: This has been added to the discussion of illegal shooting in "factor (E)".

Comment: The conservation assessment claims that because human-caused mortality in the Blue Range population is in-line with FEIS mortality-rate projections, it is not considered a threat to the population at the current time; this is not a logical argument. The threat posed by illegal mortalities should be measured by how it limits the growth of the population.
Response: The conservation assessment provided comparison to the FEIS for perspective on the current situation as opposed to what was considered likely during the planning stages of the reintroduction. However, the commenter is correct that whether or not the mortality rate is higher or lower than projections does not provide definitive proof that such a rate is not a threat to the population. Rather, the mortality rate should be considered in the context of the population's current status. The text has been modified in response to this comment to describe the impact of vehicular collision ("factor (A)" and illegal shooting, "factor (E)").

Comment: There is no logical connection between the vigilantism of a few criminals (illegal killing of wolves) and public opinion within the larger population.
Response: The conservation assessment did not intend to imply that illegal killing by vigilantes represented a majority opinion on wolf reintroduction. The assessment was unclear in discussing two separate issues; the general issue that public opinion is an important component of successful wolf reintroduction, and the more specific issue of illegal killing as a mortality source. "Factor (E)" now clearly distinguishes between these two issues in response to this comment.

Comment: There have been at least 2 Mexican wolf litters euthanized because they were hybrids. Intense management, similar to the red wolf program, may be necessary to keep wolves and dogs or coyotes from hybridizing.
Response: Hybridization between red wolves and coyotes has required intense management by the red wolf program (USFWS 2007), but so far has not been a significant issue for the Mexican wolf. In response to this comment, hybridization has been added to "factor (E)" and is not identified as a threat to the Mexican wolf.

The Conservation Principles of Resiliency, Redundancy, and Representation
Comment. Page 49. The conservation assessment states, "With several factors hindering the progress of the Blue Range population in achieving the objective of at least 100 wolves in the wild, the population is not as secure or self-sustaining as it could be." The term "self-sustaining" is an absolute; delete "as it could be".
Response: In the draft conservation assessment, the introductory text of this section served as both a conclusion to the preceding threats assessment as well as a lead in to the discussion of the "3 R's". In the final conservation assessment, a new discussion of cumulative threats has been added to the end of the threats assessment, resulting in modification to the beginning of the 3 R's" introduction and removal of the language identified by the commenter. However, in response to this comment, vague or modifying phrases such as "as it could be" have been removed from the document to the extent possible.

Comment: Based on the principles of *resiliency*, *redundancy*, and *representation*, Quay County, New Mexico, is not suitable for the reintroduction of Mexican wolves. Quay County lacks the prey base to support a population of wolves, has a relatively high road density, less than 2 percent Federal land, extreme environmental events including persistent drought, wildfire, and disease epidemics, and lacks habitat cover, available water, and suitable den sites.
Response: The principles of *resiliency*, *redundancy*, and *representation* provide a useful framework for evaluating and describing current and future conservation and recovery efforts for the Mexican wolf. Future analysis of possible reintroduction sites for wolves in the Southwest would include an evaluation of the types of features mentioned in this comment and would eliminate areas that are unsuitable for wolves.

Comment: Page 50. The principles of *resiliency*, *redundancy*, and *representation* are not helpful. They are contrived terms that force all factors involved in conservation of Mexican wolves into these categories. Mexican wolves do not seem to be *resilient*, but that is because the population has not expanded in recent years due to human-caused mortality and low

breeding success and litter size. *Redundancy* is somewhat pejorative and suggests unnecessary populations, unlike the real reasons for multiple populations, including the need for multiple genetically-connected populations, each of significant size. Further, the attempt to reflect the historical distribution of Mexican wolves across the landscape is a reasonable goal. *Representation* is difficult to interpret in a genetic sense. Different populations may have different genetic variation, but genetic exchange maintains this in the total population.
Response: The principles of *resiliency*, *redundancy*, and *representation* are not intended to alter or constrain scientific thinking related to concepts such as demography, habitat suitability, genetic fitness, or any other relevant topic. Rather, as the conservation assessment explains, the Service has adopted these terms as a communication tool to describe conservation and recovery efforts for the gray wolf to the general public. The Service acknowledges that these terms may be perceived as placing somewhat artificial construct around aspects of recovery that are interdependent and should not be considered in isolation (see "Conclusion"). For example, the number and distribution of wolves appropriate for recovery may be influenced not only by habitat suitability and availability, but also by genetic considerations. However, the conservation assessment explains the scientific rationale for each of the principles (e.g., *redundancy* does not support the establishment of multiple populations for the sake of *redundancy* itself, but rather because it increases the likelihood of persistence of the species in the face of environmental variability) and recognizes that these concepts should not be considered in isolation of one another. Further, the assessment recognizes that an absolute value for the *resiliency*, *redundancy*, and *representation* necessary for recovery does not exist, rather varying degrees of *resiliency*, *redundancy*, and *representation* may be appropriate given a specific set of circumstances. The Service continues to use the best available information while simultaneously striving to communicate such information in a manner accessible to a broad audience of affected individuals across multiple regional gray wolf recovery efforts.

Comment: The conservation assessment states that *resiliency* means that species that are "more numerous and widespread are more likely to persist" and provides estimates of population viability from a hundred to a thousand or more. The Southwest is a very different ecosystem than the Northwest and Great Lakes states – it is arid, with limited prey and probably supported fewer wolves historically. The conservation assessment also promotes *redundancy*, but if the current area is a failure, why would expanding the reintroduction be successful? It appears as if the Service is insensitive to the negative effects on rural populations of humans by promoting the expansion of the Mexican wolf.
Response: The conservation assessment does not recommend a wolf population size that is appropriate for the Southwest, but presents a range of viability estimates to demonstrate that a range of potentially appropriate numbers have been discussed in the scientific literature relative to gray wolves. Similarly, the conservation assessment does not recommend a number of populations appropriate for the Southwest, but presents the range of numbers that are available in the scientific literature or other gray wolf recovery plans. The ecological characteristics of the Southwest are a critically important consideration in Mexican wolf reintroduction, as are the social and economic characteristics of the region. The Service is legally required to pursue gray wolf recovery pursuant to the ESA, but strives to do so in a manner that is socially and economically responsive to the people living in or near wolf-inhabited areas. No change has been made in response to this comment because the text

already states that appropriate notions of *resiliency*, *redundancy*, and *representation* for the Southwest will be context dependent.

Resiliency

Comment: No reputable scientist has ever stated that a population of 100 wolves would be sufficient to avoid extinction in the long term. Thus, the "extinction risk" should be considered as certain.

Response: As the conservation assessment states in its discussion of viability (in "*Resiliency*"), it is appropriate from a scientific perspective to discuss the *degree* of extinction risk faced by a species rather than to state definitively that the species is "at risk" or "not at risk" (and see Vucetich et al. 2006). The conservation assessment does not quantify the degree of extinction risk faced by the population. However, given the population decline of the Blue Range population in the last few years, its small size, and high mortality/removal rate, it is qualitatively possible to state that the population clearly has a degree of extinction risk not commensurate with what should be a recovering population. The text has been modified in response to this comment through the inclusion of a new discussion on the cumulative effects of identified threats in "factor (E)".

Comment: Neither the Mexican wolf program or the conservation assessment can change the goals of the ESA from preventing species extinction to optimizing conditions or levels for a viable population.

Response: The commenter is correct; the ESA is intended to prevent species extinction rather than optimize conditions or population levels. The discussion of *resiliency* and viability presented in the conservation assessment reviews estimations of viable populations as they are presented in the scientific literature, followed by estimations of viability that have been applied in former gray wolf recovery plans. Typically, the Service and a recovery team would determine how information on viability should be applied to a listed species.

Comment: A peer-reviewed viability analysis of the objective to establish a population of at least 100 wolves in the BRWRA should be conducted.

Response: The Service will consider this recommendation as it schedules upcoming workload projects in 2010-2011.

Comment: Page 56. Comparing Mexican wolves to other gray wolves provides an overly optimistic conclusion; Mexican wolves are probably less *resilient* than other gray wolves due to their low litter size and low population growth rates.

Response: This consideration has been added to the new discussion of the cumulative effects of threats in "factor (E)".

Comment: Page 50. In the discussion of *resiliency*, the conservation assessment should state that given the lack of data specific to the Mexican wolf (as opposed to the gray wolf in other environments), management for persistence should stress achieving the highest possible population size. It is instructive to see that the three references cited show increasingly larger populations as the research becomes more recent; this suggests that managers should strive to maximize the population to minimize the danger of extinction when dealing with the unknown and imprecise.

Response: A conservation strategy for the Mexican wolf should include consideration of a number of variables, including environmental conditions, biological characteristics of the Mexican wolf, and an acceptably low risk of extinction. The conservation assessment is not intended to serve as a strategy for the future of the Mexican wolf program, but rather to highlight items of importance for incorporation into management decisions. Therefore, no change has been made in response to this comment.

Comment: In the discussion of *resiliency*, the conservation assessment should include a summary statement that recommends managers pay particular attention to promoting the formation and preservation of breeding pairs based on the Vucetich et al. 1997 study.
Response: The purpose of the conservation assessment is not to make recommendations, but rather to provide information to decision makers and interested parties. A modified version of this comment has been added as a summary statement, as the commenter correctly points out that research suggests that the social structure of wolves is an important consideration in their extinction risk.

Comment: In the discussion of *resiliency*, the conservation assessment should point out that political influence has been one reason for differences in estimations of viability of gray wolves, otherwise the reader will think that differences result solely from science-based disagreements.
Response: The conservation assessment provides an overview of viability based on the scientific literature. The scientific literature cited is not politically biased, and as such demonstrates that estimations of viability differ within the scientific community. Recovery criteria are by law required to be objective and measurable, and in the case of the gray wolf have been developed by gray wolf experts on several recovery teams over the course of several decades. Political factors may affect the implementation of recovery actions, but that is not an appropriate subject within the conservation assessment's scientific discussion of *resiliency*.

Comment: It is a catch-22 that the scientific literature doesn't recommend a specific number or range of populations appropriate for conservation efforts; this will result in a never-ending conservation effort and continual micro-management.
Response: The ESA is not intended to provide permanent protection for listed species; rather, it is supposed to provide "emergency room" conservation for species on the verge of extinction. When their status has been improved sufficiently, they are delisted. The conservation assessment makes the point that one specific formula for gray wolf recovery has not been identified by the scientific literature but that there is likely a range of appropriate formulations of population abundance and distribution that will ensure wolves are able to sustain themselves in the wild. The Service has attempted to delist the gray wolf in the Northern Rockies and the Great Lakes, demonstrating that the agency does not intend to continue gray wolf recovery efforts indefinitely.

Comment: Page 53. I believe another legitimate explanation for the variability in estimations of viability is an inherent tendency within government agencies toward establishing minimal standards for species recovery.

Response: The Service strives to recover species such that they no longer meet the ESA's definition of threatened or endangered. This is a minimal standard compared to, for example, broader conservation goals to maximize species abundance or diversity in a specific area.

Redundancy
Comment: Information on habitat suitability for Mexican wolves is available in the Defenders of Wildlife publication, Places for Wolves.
Response: The conservation assessment has incorporated the findings contained in this piece of literature.

Comment: Page 54-56. *Redundancy* should not be pursued until the BRWRA population target of 100 has been reached. The captive population provides redundancy and a "safety net".   This should allow the agencies and public to focus on the BRWRA until data gaps are filled instead of moving forward with expansion of the reintroduction.
Response: The conservation assessment is not a strategy that recommends or dictates future recovery actions, therefore no change to the text has been made in response to this comment. Although the captive population does provide the source of wolves for the reintroduction, it is not intended as a redundant population for the purpose of recovery, nor should it be viewed as a "safety net" for the Blue Range population.

Representation
Comment: Page 59. The interpretation of Lande (1988) is outdated.
Response: In order to acknowledge current scientific consensus that genetic effects can be drivers of small population extinction (Allendorf and Luikart 2007), this statement and reference have been removed.

Comment: Page 62. Genetic stochasticity is not a commonly used term in population genetics; mutation, recombination, genetic drift, and gene flow could all be considered stochastic.
Response: The term "genetic stochasticity" has been removed from the document.

Comment: Wolves may be instinctively avoiding their artificially chosen mates to avoid inbreeding. Wolves may be having trouble understanding natural relationships because they get shuffled around as mates are selected for them.
Response: Minimization of inbreeding is one of the AZA's primary considerations when wolves are paired for breeding. There is no indication that wolves are having trouble understanding natural relationships in the captive or wild populations, given that successful reproduction occurs in both populations. No data or literature source was provided in support of this comment; therefore, no change to the text was made.

Comment: The Mexican wolf can never achieve true genetic diversity because it began with a limited genetic pool. It will always be subject to the defects of inbreeding and cross breeding with coyotes and domestic dogs.
Response: As the conservation assessment states, the SSP captive breeding program strives to maintain as much of the genetic diversity of the founding wolves as possible. As current research has shown and is discussed in the conservation assessment, the effects of inbreeding

have been detected in the captive and reintroduced populations, but can be minimized by appropriate pairing of wolves (Asa et al. 2007, Fredrickson et al. 2007). While breeding between Mexican wolves and coyotes and Mexican wolves and dogs has the potential to occur, it is not occurring at a level that puts the genetic integrity of the reintroduced population at risk at the current time; this finding is provided by a new discussion of hybridization in "factor (E)" in response to this comment. The conservation assessment clearly states that management of the genetic diversity of the Mexican wolf remains a critically important component of the recovery program.

Comment: Although [Mexican wolf] captive management is science-based and exemplary, recent research indicates that after several generations in captivity, animals lose the genes for characteristics essential to success in the wild. The discussion of the genetic viability of the captive population should include relevant literature on the effects of captivity over time. See Frankham R. 2008. Genetic adaptation to captivity in species conservation programs. Molecular Ecology 17 (1): 325-333.
Response: The findings of Frankham's (2008) research have been added to the conservation assessment.

Comment: Page 62. The AZA has requested that SOP 13 be suspended until a more scientific, genetic, demographic and wolf-behavior based approach can be implemented; this request should be reflected in this document as are the contributions of other scientific groups.
Response: This information has been added to the text.

Comment: The combining of the three lineages of Mexican wolf appears to have positively influenced genetic fitness of first- and second-generation crosses. However, the (effective population size of the) wild population must expand rapidly in the near future or genetic variation and fitness in the wild population will decline. Unless the Service improves the genetic management of the Blue Range population (e.g., by removing non-reproductive, highly inbred McBride wolves and introducing new genetically valuable wolves), genetic factors may play an inordinate role in the future "health" of the population.
Response: In response to this (and several related) comment, a discussion of inbreeding has been added to "factor (E)" based on the results and recommendations of Fredrickson et al. 2007. As the conservation assessment reiterates, genetic concerns are one of several issues that must be balanced during decisions to release or remove wolves. However, the Service is aware of the effects of its release and removal actions on the genetic diversity of the population. In May 2009, the Service and its partners approved a Clarification memo to SOP 13 that addressed genetic considerations as well as other circumstances in removal decisions. In December, 2009, the Service reached a settlement agreement with environmental plaintiffs that challenged SOP 13, which stated, in part "the Service shall make no further decisions that relate to the Mexican Wolf Recovery Program pursuant to SOP 13 as issued on April 30, 2005, or as altered by the Clarification Memo on May 28, 2009 (Defenders, et al. v. U.S. Fish and Wildlife Service, et al., 08-cv-280 (D. Ariz.)).

Comment: Page 62. It is important to expand the wild population rapidly to improve the retention of existing genetic variation among Mexican wolves beyond that possible in the limited space available in captivity.
Response: The new discussion of inbreeding in "factor (E)" includes this information.

Comment: Page 62. The assessment should note that Fredrickson et al. (2007) recommend adjusting the ancestry representation in the Mexican wolf population to 50-25-25. Achieving this goal in the wild population will require aggressive, targeted management actions by the Service and cooperating agencies. The conservation assessment should recommend the immediate development and implementation of a Genetics SOP.
Response: The conservation assessment has been revised to incorporate Fredrickson's recommendation (see the discussion of inbreeding in "factor (E)"). The conservation assessment, as previously stated, is a compilation of information rather than a strategic document containing recommendations, and thus does not provide a recommendation for the immediate development and implementation of a Genetics SOP. This comment is under consideration by the Service.

Comment: Page 63. How was the estimate of effective size (0.28 times the census population) developed? Given the genetics issues, consistent reproductive failures, and high loss of breeders in the wild population (i.e., alpha pack members are frequently removed by agency members or illegally killed), this estimate seems high. Calculations of genetically effective population size consider only breeding age adults and exclude immature animals. Frankham (1995) concludes that wildlife populations have "much smaller effective population sizes than previously recognized", averaging only 0.1 to 0.11.
Response: The estimate of effective population size was developed by dividing the number of breeding adults in the population by the census population size. Clarifying text has been added to explain the methodology and offer perspective on the estimate in response to this comment.

Comment: Page 64. The most understated threat in this assessment to the long-term security and viability of Mexican gray wolves is the threat of genetic deterioration in both the captive and wild populations. Population geneticists warn about the potential adverse effects of severe population bottlenecks and recommend rapid expansion of the population following bottlenecks to avoid additional loss of genetic variation. They also warn about the deleterious effects of holding populations in captivity over multiple generations. When assessing the genetic viability of the reintroduced BRWRA population, the establishment of that population from a relatively small number of released animals from the captive population that survived, reproduced, and eventually contributed to the gene pool of the wild population should be considered a second bottleneck event for the Mexican gray wolf.
Response: In response to this comment, discussion of the deleterious effects of holding populations in captivity over multiple generations has been added to the conservation assessment (Frankham 2008) an discussion of inbreeding has been added to "factor (E)".

Comment: There seems to be a continued disconnect between the Service's management of the Blue Range population and the establishment of a genetically diverse population. Currently, the Blue Range has a narrow genetic base with descendents of the former

Bluestem and Aspen packs dominating the ranks of the alpha wolves. Bluestem is especially overrepresented. If not dealt with, this will increase inbreeding and reduce fitness in the Blue Range population in future generations.
Response: As the conservation assessment states, the genetic diversity of the reintroduced population is one of many factors that must be balanced by the Service and its partners in managing the reintroduction. In response to this comment, text has been added to the conservation assessment (see "factor (E)") to highlight the disconnect between current regulatory and management mechanisms and management of genetic issues. The commenter's opinion that the genetic diversity of the population is not appropriately prioritized is acknowledged and under further consideration by the Service.

Comment: Page 58. Expand the discussion of ecosystem *representation* to include the emerging concept of "ecological effectiveness" and the importance of establishing and maintaining ecologically effective densities of "strongly interacting species" (see Soule et al. 2003 and 2005, referenced elsewhere in this document). Recognition of the concept of ecologically effective densities in establishing recovery goals is critical to achieving the ESA purpose of conserving ecosystems upon which endangered and threatened species depend. (120)
Response: This information has been incorporated to the conservation assessment, although not in the form of a recommendation.

Comment: The conservation assessment appropriately points out two types of *representation*, genetic and ecosystem. The Service should consider both of these in all of its policy and management decisions.
Response: The Service recognizes the importance of both types of *representation* as important components of conservation. No change has been made to the document, as the conservation assessment does not contain recommendations.

Comment: Page 59. The conservation assessment's discussion of the importance of effective population size (rather than census population size) on genetic health of a population make the Service's disregard for the Final Rule's definition of breeding pair particularly troubling.
Response: The Service considers its interpretation of breeding pair to be consistent with the Final Rule's definition.

Comment: There seems to be a lack of concern or understanding that the best biological opportunity to broaden the genetic base, increase fitness, and accelerate population growth of the Blue Range population is closing with the aging of the F_1 generation of captive-bred wolves. Likewise, opportunities are now also limited for using backcross wolves (MB x F_1) for genetically augmenting the Blue Range population.
Response: The Service and its partners are aware of the opportunity and importance of improving the genetic base of the Blue Range population to increase fitness and accelerate population growth. AMOC and the IFT continue to strive to find the appropriate balance between the many management concerns facing the reintroduction project. Discussion of inbreeding has been added to "factor (E)" to address the commenter's concerns.

Comment: Page 60. The conservation assessment should distinguish between the excellent genetic management of the captive program and the spotty performance of the Service in properly prioritizing genetic issues in the reintroduced population after the initial release of wolves into the BRWRA.
Response: The text has been modified to separate description of the management of the captive and reintroduced populations when genetic issues are being discussed due to differences in the degree of prioritization that genetic concerns receive in each. As the conservation assessment states, the genetic health of the reintroduced population is one of many issues that the Service and its partners consider when making management decisions.

Comment: The Mexican wolf reintroduction is hindered by a lack of genetic diversity. Regardless of the end goal, there will never be more genetic diversity unless Mexican wolves are interbred with coyotes or other wolf subspecies.
Response: The genetic diversity of the reintroduced Mexican wolf population is limited by the genetic diversity maintained from the seven Mexican wolves upon which the captive breeding program was founded. As the conservation assessment describes, the AZA Mexican wolf SSP maintains the maximum genetic variation possible given the current carrying capacity of the population. Breeding of Mexican wolves and coyotes will not be pursued as a conservation strategy pursuant to the ESA because this would result in hybrid animals that would not be protected under the statute. The introduction of gray wolf genes into the Mexican wolf captive breeding program is not currently under consideration. No change to the text has been made in response to this comment.

CONCLUSION
Comment: Page 64. The conservation assessment states that the Blue Range population is not at immediate risk of extinction "due to the existence of over 300 wolves in captivity and the ability of management to bolster the population with captive wolves in response to a major population fluctuation or noticeable decline in fitness." The idea of a "captive safety net" is illusory and not supported by the Final Rule, which states, "If captive Mexican wolves are not reintroduced to the wild within a reasonable period of time, genetic, physical, or behavioral changes resulting from prolonged captivity could diminish their prospects for recovery."
Response: The Service agrees that the project should not rely on the captive population as a safety net. The draft conservation assessment stated in the paragraph following the quoted material that the purpose of the ESA is to recover a species in the wild such that it has a reasonable likelihood of persistence without intensive management. The findings of the Frankham (2008) paper have been added to the conservation assessment in the section "*Representation*".

Comment: Page 8 and 64. The conservation assessment states that for the success of the Mexican wolf program, the Service desires to let the wolf roam to other areas outside of the BRWRA. This statement is not logical because the BRWRA is the least densely human populated area in the Southwest, with an abundant prey base. Yet, the program is not a successful experimental population. If the current population cannot survive, why would one think it would thrive better in other areas with greater human population densities and a smaller prey base?

Response: The conservation assessment does not explicitly recommend the expansion of the Mexican wolf reintroduction. Rather, it indicates that characteristics of a recovered species, including viable size and distribution, inhabitance in multiple sites of high quality habitat, and adequate genetic variation, are not achieved by the Blue Range population. The Service acknowledges that the current reintroduction project offers much in the way of "lessons learned" that can be applied as the conservation and recovery effort continues. Human and prey density continue to be considered critical considerations in wolf reintroduction and recovery. No change to the text was made in response to this comment.

Comment: Page 64. Intensive management in the form of excessive lethal control and removal of wolves could be argued to be posing some level of extinction risk to the population.
Response: Hypothetically, lethal control and removal of wolves could occur at a level sufficient to put the population at risk of extinction. However, control actions are considered necessary by the Service and its partners to respond to wolf-related conflicts that occur in the communities living in and near the BRWRA to promote acceptance of the reintroduction project. The balance of gaining and maintaining social acceptance and managing to promote population growth is a difficult balance that has not yet been achieved in the BRWRA. Discussion of the adequacy of regulatory and management mechanisms is provided in "factor (D)", therefore no change to the text has been made in response to this comment.

Comment: The conservation assessment blames the lack of recovery criteria for an inability to gauge the contribution of the current reintroduction to recovery. There is plenty of information on which to gauge the current population, its management, and associated policies with biological recovery.
Response: Recovery criteria would provide an important benchmark against which the current population could be measured. However, as the commenter states, there is adequate information to draw a number of conclusions about the status and progress of Mexican wolf recovery, and the conservation assessment attempts to emphasize these in the Summary Statements provided.