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FOR DISCUSSION BY MEXICAN WOLF RECOVERY TEAM – 9/16/2011

Draft Mexican Wolf Revised Recovery Plan

Sections I.g, III, and Appendix B

NOTE TO RECOVERY TEAM ON THE CONTENT OF THIS DOCUMENT

The work of the Recovery Team Science and Planning Subgroup to date has primarily focused on two key aspects of the recovery plan: 1) biogeography, as it informs identification of the appropriate geographic area in which to focus recovery efforts, and 2) recovery criteria. These are presented in this document as drafts of Recovery Plan Sections 1.g. (page 1) and 3 (page 18). Additionally, Appendix B (page 43) provides more details on the analyses supporting development of recovery criteria. This material represents the conclusions of the Subgroup, with the exception of one member who has prepared a dissent that has been made available to the team (J. Heffelfinger, USFWS files).

Several questions at the August recovery team meeting focused on 1) the potential for genetic management to increase effective population size, and 2) availability of suitable habitat in Mexico and the United States, especially Texas. The current document contains summary information on these issues (on page 36 (genetics) and pages 11 and 42 (habitat)) and describes the process the Science and Planning Subgroup is using to assemble the best available information on these topics. A detailed discussion of these topics will be contained in the document made available to the team at the next team meeting.

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SECTION I.g. GEOGRAPHY OF RECOVERY

As the Science and Planning Subgroup of the Mexican Wolf Recovery Team began envisioning the recovery of the subspecies, it determined that the plan should contain an explicit identification of the geographic area appropriate for recovery efforts. The Subgroup wanted to "put recovery on the map" by broadly defining where recovery efforts, including the (re)establishment of wolf populations specified by recovery criteria, would be ecologically feasible and scientifically sound in the southwestern U.S. and Mexico. An explicit statement was considered necessary due to the existence of varying prior depictions of Mexican wolf historic range, new genetic information related to historic range, knowledge that contemporary habitat conditions differ from historic habitat conditions, and knowledge that the current quality and quantity of habitat available to support recovery efforts is in limited supply. These factors create a complex landscape for discussing Mexican wolf recovery, thus the Subgroup felt compelled to compile and synthesize relevant scientific information. The recovery plan's delineation of the "Mexican wolf recovery area" does not confer any regulatory standing or restrictions under the ESA or other statute (e.g., this area is not considered essential as critical habitat under section 4 of the ESA), although as a compilation of scientific information it is intended to inform future regulatory processes related to recovery plan implementation.

Based on the material below we recommend that the Mexican wolf recovery area include Mexico, extreme western Texas, Arizona, New Mexico, and the southern portions of Utah and Colorado. This recommendation, and the material presented below, are endorsed by the Science and Planning Subgroup with the exception of Jim Heffelfinger, who has submitted a dissenting opinion to the recovery team (J. Heffelfinger, U.S. Fish and Wildlife Service files).

Relevant Policy and Science

In 1974 the first list of species protected under the ESA included the northern Rocky Mountain wolf (*C. l. irremotus*) (Federal Register 39:1171). In April 1976 the Mexican wolf was listed as endangered (Federal Register 41:17736-17740), and in June 1976 *C. l. monstrabilis* was listed as endangered (Federal Register 41:24062-24067). In 1978, because of the confusing taxonomy of wolf subspecies and rudimentary knowledge of subspecies' historical ranges, the U.S. Fish and Wildlife Service (USFWS) combined the subspecific listings of the gray wolf and reclassified it at the species level (i.e., *Canis lupus*) as endangered throughout the Holarctic biogeographic region and Mexico, except for Minnesota where the species was reclassified to threatened (Nowak 1978).

Typically the recovery area for any threatened or endangered species is defined by the listing in the Code of Federal Regulations. For the Mexican wolf the relevant listing is for the gray wolf (*Canis lupus)* [CFR 17.11(h)]. That listing's lack of specificity concerning an area for Mexican wolf recovery creates a need to define an ecologically suitable region for the effort.

Given the understandable tendency of recovery programs to focus on a species "historical range", it is important to note the phrase's legal definition: "known general distribution of the species or subspecies as reported in the current scientific literature" [CFR 17.12(e)]. For the Mexican wolf the "current scientific literature" has changed over time fueling disagreement about the subspecies' historical range. To some extent, the disagreement is an inevitable result of the inherent difficulty of understanding the relevance of historical records to future conditions (Wiersma and Sandlos 2011).

A differential focus on historical range is not supported by the language of the ESA and related USFWS policies. There is no direct reference to historical range in the ESA, and only one ESA-related policy makes reference to it [50 CFR 17.81(a)]: *The Secretary may designate as an experimental population a population of endangered or threatened species that has been or will be released into suitable natural habitat outside the species current range (but within its probable historic range) ...*". But even here the Director has administrative room based on current conditions [50 CFR 17.81(a)]: *an experimental population can be established outside species historic range if the Director finds that the primary habitat of the species has been unsuitably or irreversibly altered or destroyed*."

Since the Mexican wolf was seemingly extinct in the wild when the recovery program began, reintroduction projects are necessary to restore populations that count toward recovery. Successful reintroduction projects require consideration of unique circumstances (e.g., which animals to release where and how) that are irrelevant to recovery programs based on strategic management of extant populations (e.g., gray wolf recovery in the western Great Lake states). As a scientific discipline restoration ecology presents a body of reliable knowledge that is well suited to considering such unique circumstances. Consequently, we consider restoration ecology to be an important scientific paradigm for guiding Mexican wolf recovery.

While this discipline provides specific instruction that restoration ecologists must be purposefully diligent in selection of reference points and ultimate intent, it does not define *a priori* what ultimate intent is most desirable. For example, while much emphasis can be placed on historical conditions, restoration ecology does not focus solely on such conditions (Bradshaw 2002, Nuttle et al. 2004). As Falk (1990) puts it, "Restoration uses the past not as a goal but as a reference point for the future. If we seek to recreate the temperate forests, tall grass savannas, or desert communities of centuries past, it is not to turn back the evolutionary clock but to set it ticking again."

Historical conditions of a given landscape may be less informative now and in the future due to changes brought about by increasing human population and resource use, changing climates, and disrupted disturbance regimes (e.g. fire and insects), the combination of which may render moot many historical reference points (Hansen 2009, Orr 2010, Brown 2011). For example, studies are now documenting that fish and wildlife resources are shifting historical ranges (and habits) due to changing climate (Peters and Lovejoy 1992, Schneider and Root 2002, Chen et al. 2011, Pearson 2011). In many areas of the western US changes in climate are leading to earlier melting of spring snowpacks and increases in the frequency, sizes and duration of large wildfires (Westerling et al. 2006). In the southwestern US, the combination of changing climate, fire, and bark beetles may result in large-scale changes in forest area and habitats (Breshears et al. 2005, Adams et al. 2009, Williams et al. 2010).

A differential focus on historical conditions can lead to inadequate consideration of data that reveal the importance of current range and future range for instructing recovery planning and implementation. We know, for example, that historical data indicate that Mexican wolves preyed extensively on the diminutive Coues white-tailed deer (*Odocoileus viginianus couesi*) prompting some to suggest that the subspecies was an ecological or habitat specialist (Brown 1983:6-12). An early and reliable assessment of Mexican ecology was completed by McBride (1980). On the notion that the Mexican wolf was a habitat specialist fine-tuned to the Madrean montane forests, evergreen woodlands, and adjacent grasslands in Mexico, extreme southeast Arizona, and southwest New Mexico (Brown 1983:7), McBride (1980:13) wrote: *"While it might appear that wolves are attracted to certain vegetative associations, they are actually responding to the availability of prey."*

Historically Mexican wolves in Mexico probably preyed differentially on Coues white-tailed deer simply because of its relative abundance. Supporting this notion are studies that indicate that elk (*Cervus elaphus*) are the primary prey of Mexican wolves occupying the BRWRA, despite an abundance of deer (Reed et al. 2006, Carrera et al. 2008, Merkle et al. 2009). Consequently, the Mexican wolf recovery plan should be based on the expectation that Mexican wolves can successfully subsist on both small <u>and</u> large ungulates.

A comprehensive approach to endangered species recovery that recognizes the importance of historical <u>and</u> contemporary conditions is supported by leading ecological research (Lomolino 2006) and has been used by the USFWS to support important projects. For example:

- While there is no evidence that black-footed ferrets (*Mustela nigripes*) ever occupied habitat outside Janos, Mexico the USFWS supported the reintroduction of ferrets there because the area supports the largest remaining colony of black-tailed prairie dogs (*Cynomys ludovicianus*) (http://www.fws.gov/mountain-prairie/species/mammals/blackfootedferret/archives.htm)

- While there is no evidence that black-footed ferrets ever occupied the shortgrass prairie of New Mexico, the USFWS supported the release of ferrets to such an area at Vermejo Park Ranch in the north-central portion of the state because of the presence of a large colony of black-tailed prairie dogs (Truett et al. 2006). All historical records for the state indicate that ferrets were sympatric with Gunnison's prairie dogs (*Cynomys gunnisoni*) (Anderson et al. 19??) that occupied colonies in higher elevation grasslands.
- While some evidence indicates that California condors (*Gymnogyps californianus*) did not occupy the Grand Canyon area of northern Arizona historically, the USFWS supported the release of birds there (Mesta 1996).
- While Cherry Creek in southwestern Montana was historically devoid of fish, a westslope cutthroat trout (*Oncorhynchus clarki lewisi*) population recently established there (TESF unpublished data) was nonetheless recognized as important by the USFWS when denying the petition to list the subspecies under the ESA.
- While some believe that the gray wolf (*Canis lupus occidentalis*) from Alberta and British Columbia never occupied central Idaho and the Greater Yellowstone Ecosystem (Nowak 1995), the USFWS supported the translocation of such animals to those areas because of the similarity of habitats and prey (Fritts et al. 1997).

Leading biogeographic research shows that historical sources are confusing and often misinterpreted and misused (Wiersma and Sandlos 2011). For contemporary patterns of extinction and endangerment the general pattern is one of persistence of peripheral rather than central populations (Channell and Lomolino 2000a, 2000b, Lomolino and Channell 1995, 1998; Abbitt et al. 2000, Nielsen et al. 2001). From this Lomolino (2006) argues that "*... searches for undiscovered populations of imperiled species and sites for introductions should include the periphery of historic and possibly prehistoric ranges*."

In an increasingly dynamic and uncertain world (Dimento and Doughman 2007, Brown 2011, Orr 2010), recovering taxa outside purported historical ranges based on diligently assembled scholarship from the best available science may establish a useful and critically important precedent (Lomolino 2006). This will likely be especially true for species defined by many subspecies characterized by extensive historical distributions. Such an approach to endangered species recovery will allow such species and subspecies to experience greater security than a less comprehensive approach based on a differential focus on historical conditions. The Mexican wolf is one such subspecies: it arises from a species that is defined by many subspecies all of which were ecological generalists with historical ranges that included wide zones of ecologic and genetic integradation (Brewster and Fritts 1995, Mech and Boitani 2003:11-17, Von Holdt et al. 2011, Chambers et al. submitted)

The Basis for Historical Ranges for *Canis lupus baileyi*

Based on morphology (mostly skull and pelage characteristics) some researchers (Young and Goldman 1944, Hall and Kelson 1959, Hall 1981) believed that as many as 24 gray wolf (*Canis lupus*) subspecies historically occupied North America, including 5 that occurred in the southwestern United States and Mexico: *C. l. baileyi, C. l. mogollonensis, C. l. monstrabilis, C. l. nubilus, and C. l. youngi* (Figure 1).

Based on a contemporary analysis of skull characteristics, Bogan and Mehlhop (1983) found that *C. l. baileyi* and *C. l. youngi* were the most distinct southwestern subspecies and that *C. l. mogollonensis* and *C. l. monstrabilis* were intergrades of the two. They concluded their work by recommending that the range of *C. l. baileyi* be expanded by hundreds of kilometers to the north and northeast to accommodate the ranges of *C. l. mogollonensis* and *C. l. monstrabilis*. This conclusion was adopted by the USFWS in the 1982 Mexican wolf recovery plan (U.S. Fish and Wildlife Service1982) (Figure 2).

Nowak (1995) arrived at a different conclusion and included *C. l. mogollonensis* and *C. l. monstrabilis* with *C. l. nubilus* when he recommended that the North American gray wolf be described by five subspecies (Figure 3). His recommendation included a smaller historical range for *C. l. baileyi* than proposed by Bogan and Mehlhop (1983) (Figure 2). Notably, Bogan and Mehlhop (1983) conducted a more exhaustive study (assessment of 253 skulls based on two statistical approaches) compared to Nowak's (1995) work (assessment of 88 skulls based on one statistical approach).

Even though Nowak (1995) did not expand the range of *C. l. baileyi* to accommodate *C. l. mogollonensis* and *C. l. monstrabilis*, nearly a decade earlier he had endorsed the reintroduction of the Mexican wolf "*beyond its designated range on the grounds that it could have occupied such sites naturally, if other wolves had not already been there, and indeed, may have been attempting to do so after the other wolves had been extirpated.*" (Nowak 1986).

Other researchers also commented on *C. l. baileyi's* capacity to occupy recently vacated habitat. Scudday (1972) reported on two male Mexican wolves collected in 1970 in Brewster County, Texas and concluded that that *C. l. baileyi "was a late comer to Texas, probably moving in as C. l. monstrabilis was eliminated in the Trans-Pecos region."* Gish (1977 as cited by USFWS 1982) thought that *C. l. baileyi* increasingly moved into Arizona from Mexico and southwestern New Mexico as other subspecies were eliminated in Arizona. Nowak (1995:385) noted that a male Mexican wolf taken in 1957 near Concho, Arizona, was well within the original range of *C. l. mogollonensis*. Curiously, Nowak (1995) made no reference to the significance of these three recently collected wolves to Mexican wolf recovery. Years later he did, however, conclude that for recovery planning purposes the specimens represented a 160-km northward extension to the historical range that he had constructed for the subspecies in (R. M. Nowak personal communication 2002).

It is important to note that Bogan and Mehlhop (1983) and Nowak (1995) agreed that the range of *C. l. mogollonensis* in Arizona was a transition zone where *C. l. baileyi* intergraded with more northern *C. lupus*. It is logical to expect that similar intergradation was occurring in the range of *C. l. monstrabilis* in New Mexico (Brown 1983:24-25).

As a whole, research on the morphology of gray wolves in the Southwest support the contention that a broad area of reproductive interaction throughout Arizona and New Mexico occurred between *C. l. baileyi* and several other purported subspecies of *C. lupus*.

Based on some of the information presented above, Parsons (1996) proposed expansion of the historical range for *C. l. baileyi* by extending the range assigned to the subspecies by Nowak (1995) by 320 km (200 miles) to the north and northwest (Figure 4). This new historical range was utilized in the draft Mexican wolf recovery plan (U.S. Fish and Wildlife Service 1995) and the final environmental impact statement for the Blue Range Mexican wolf reintroduction project (U.S. Fish and Wildlife Service 1996).

While appropriate, for several reasons the historical range proposed by Parson (1996) was somewhat arbitrary. It was based on the historical range proposed by Nowak (1995) rather than the one proposed by Bogan and Mehlhop (1983) (which had been previously adopted by the U.S. Fish and Wildlife Service and included in the original Mexican wolf recovery plan) and it failed to account for the Mexican wolf collected near Concho, Arizona in 1957 (Nowak 1995:385) and two Mexican wolves collected in 1970 in Brewster County, Trans-Pecos Texas (Scudday 1972) (Figure 5).

The new historical range proposed by Parsons (1996) was based on a 320 km (200 miles) extension as an expression of dispersal tendencies. Many studies justify a larger extension (Mech and Boitani 2003:11-17). For example,

- one gray wolf in North America dispersed over 885 km (550 miles) (Fritts 1983).
- a gray wolf in Finland traveled a straight-line distance of nearly 1,110 km (about 655 miles) (Mech 2011).

- a female gray wolf traveled over 4,800 km (3,000 miles) between the Greater Yellowstone Area and Colorado before being illegally killed east of Grand Junction, Colorado (U.S. Fish and Wildlife Service unpublished data).
- Merrill and Mech (2000) used satellite collars to track extensive movements by gray wolves in Minnesota and Michigan. They report that farthest distances reached ranged from 183 to 494 km (114 to 309 miles), and minimum distances traveled (sum of line segments) ranged from 490 to 4,251 km (306 to 2,656 miles).

While the movements described above were carried out by wolves inhabiting areas of relatively homogenous and suitable habitat, they do illustrate the capacity of the species to travel considerable distances. Given this great vagility, boundaries between ranges of adjacent gray wolf subspecies were wide zones of intergradation covering hundreds of kilometers where genetic mixing occurred (Brewster and Fritts 1995, vonHoldt et al. 2011).

While average dispersal distance for a gray wolf is less than about 100 km (62 miles) (Mech and Boitani 2003:11-17, U.S. Fish and Wildlife Service 2009:15126), one can argue that only a few individuals would be required to occupy an area for that area to be considered the periphery of historical range and potentially suitable recovery habitat (Lomolino 2006).

If Parsons (1996) had worked from the historical range for *C. l. bailey* as adopted by the USFWS in the 1982 recovery plan (U.S. Fish and Wildlife Service 1982), included the Concho male and two Brewster County males, or increased the dispersal distance as justified by telemetric data, the historical range he proposed for *C. l. baileyi* would have extended north to southern Utah and southern Colorado (Figure 5).

In the last few years the USFWS has collected data on movements by Mexican wolves from the BRWRA. At least a few animals have wandered widely (U.S. Fish and Wildlife Service unpublished data). Two wolves traveled to the edge of historical range (F634 -- 177 km, 111 miles; M1210 -- 158 km, 99 miles) as defined by Parsons (1996) and two beyond that range (M1039 -- 198 km, 124 miles; F594 -- 291 km, 182 miles). In the presence of a different management scheme, or absent radio-collars, these animals could have survived and reproduced (assuming the presence of other Mexican wolves) in areas well outside the historical range proposed by Parsons (1996). Movements of wolves from the BRWRA indicate that the subspecies' current range extends further north than the most recent depiction of historical range for the subspecies. The USFWS has previously recognized the importance of long distance movements by gray wolves for defining the boundaries of a recovery area (U.S. Fish and Wildlife Service 2009:15126-15127).

In an independent and exhaustive review of morphological and molecular genetics data, Chambers et al. (submitted) recommended that the historical range for *C. l. baileyi* be extended northward (Figure 7). They did not factor into their recommendation telemetric data that show Mexican wolves from the BRWRA traveling even further to the north effectively establishing a contemporary range for the subspecies that is more expansive than previously proposed historical ranges.

IUCN Wolf Specialist Group

Based on all information available at the time, in March 2000 the IUCN/SSC Wolf Specialist Group reviewed relevant information about the historic distribution of *C. l. baileyi* as they considered the suitability of the southern Rocky Mountains Ecoregion (western Colorado south thru north-central New Mexico) for the subspecies and concluded that: "*... reintroduction of Mexican wolves (*Canis lupus baileyi*) to the Southern Rocky Mountains ecosystem is appropriate pending a determination through an Environmental Impact Statement that the area is suitable for gray wolves and provided that additional scientific review determines that Mexican wolves are the most appropriate source stock*." (IUCN Wolf Specialist Group Resolution – February 23, 2000).

IUCN Conservation Breeding Specialist Group

In August 2001 during a Southern Rockies wolf population and habitat viability analysis (PHVA) conducted by the IUCN/SSC Conservation Breeding Specialist Group a large team of experts addressed the Wolf Specialist Group's desire for additional scientific review on the appropriateness of reintroducing Mexican wolves to northern New Mexico and southern Colorado. This team of experts concluded that: "*For several reasons, the Mexican wolf is the most appropriate wolf to use as a reintroduction source to the Southern Rockies*" (Phillips et al. 2000:21-22). Three independent reviewers, themselves recognized experts in wolf biology and conservation, supported the conclusion (Phillips et al. 2000:97-102).

Why did these experts support the conclusion that northern New Mexico and the southern portion of the Colorado were appropriate for Mexican wolves?

- Habitats and prey base in the Southern Rockies are ecologically similar to both that existing in the northern historical range of the Mexican wolf and the present range of the reintroduced population.
- The Mexican wolf is the closest geographic source of wolves to the southern portion of the Southern Rocky Mountains.

- The Mexican wolf is the most endangered subspecies of gray wolf and therefore would greatly benefit from this additional area.

Molecular Genetics

Genetic studies indicate that historically reproductive interactions between *C. l. baileyi* and more northern subspecies of *Canis lupus* extended across regional and continental scales (Jenks and Wayne 1992, Wayne et al. 1992, Roy et al. 1994, Forbes and Boyd 1996, Vila et al. 1999, Leonard et al. 2005, Von Holdt et al 2011, Chambers et al. submitted). These studies suggest that weak spatial patterns of intraspecific differentiation between wolf groups were the norm across large parts of the North American continent rather than pronounced demarcations as suggested by solid lines on a map. For example, based on mitochondrial DNA (mtDNA) data from historical specimens Garcia-Moreno et al. (1996) noted that: *"We cannot eliminate the possibility that some of the founding Mexican wolves were from Canada, Alaska, or a few northern United States ..."*.

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 possessed Mexican wolf genetic markers (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 descendants from a common ancestor) haplotype was found as far south as Arizona, and individuals with southern clade haplotypes (including 5 of 8 historic specimens of *C. l. baileyi*) occurred as far north as Utah, Colorado, Nebraska, and Oklahoma. In short, a genetic marker (i.e., the northern haplotype) associated with *C. l. nubilus* was found as far south as Arizona and genetic markers (i.e., the southern haplotypes) associated with *C. l. baileyi* were found as far north as Nebraska. Leonard et al. (2005) interpret this geographic distribution of genetic markers as evidence that historical gene flow among wolf "subspecies" was extensive in time and space . They concluded that this extensive gene flow supports a wide geographic mandate for the reintroduction and recovery of the Mexican wolf (Figure 8). The notion of extensive gene flow was supported by Chambers et al. (submitted) after an exhaustive review of relevant studies.

Climate Change

The science and planning subgroup has tentatively concluded that climate change is not a significant threat to Mexican wolf recovery. Regardless, it is important to note that worldwide emissions of greenhouse gases continue to exceed at an increasing rate the emission profiles included in the worst-case scenarios considered by the Intergovernmental Panel on Climate Change (Hansen et al. 2008, Hansen 2009). New data continue to confirm that fish and wildlife resources are being affected by climate change (Peters and Lovejoy 1992, Schneider and Root 2002, Pearson 2011) and an increasing number of terrestrial species are shifting ranges in latitude or elevation at an increasing rate to "escape" increasingly warm weather. Chen et al. (2011) reports: 1) range shifts are occurring two to three times faster than previously reported for a large number of terrestrial species, and 2) range shifts are most pronounced for species inhabiting areas where warming is most dramatic. Of potential relevance to Mexican wolf recovery, Mech (2004) documented an apparent effect of climate change in a decline of wolves in an area of the High Arctic. Given the increasingly disruptive nature of climate change (Orr 2010, Brown 2011), it seems prudent to identify a recovery area that is as accommodating for the Mexican wolf as allowed by the best available science.

Habitat information relevant to northern extent of recovery area

A detailed assessment of the distribution of suitable in both the US and Mexico will be included as Section 1.f. in the next draft of the recovery plan. This information is briefly summarized here in terms of its relevance to defining the northern and eastern extent of the recovery area. Three major zones of suitable wolf habitat exist in the area encompassing Arizona, New Mexico, southern Colorado and southern Utah. Under current habitat conditions, it is estimated that over 1,000 wolves could inhabit this large area (Carroll et al., 2003, 2006) (Figure 11a). In an independent assessment of habitat suitability, Heffelfinger (unpublished data) used ungulate survey and harvest data and assumptions about wolf social ecology to conclude that this area could currently support over 1,000 wolves. Primary reintroduction sites could be found within each of these areas since they all include secure core areas of high quality habitat on public or private lands subject to conservation mandates (National Park, wilderness, conservation easements) where wolves are predicted to experience relatively low human-induced mortality. These secure core areas are important because they are projected to persist as suitable habitat under future landscape change (Figure 9, Carroll et al. 2006).

The major zones of suitable habitat (Figure 9 and 11) are 1) the BRWRA and adjacent public lands, 2) the Grand Canyon and adjacent public lands, and 3) two linked areas of public lands and private lands with conservation management in northern New Mexico and southern Colorado. An appropriate northern boundary which would encompass the entirety of these three areas would be defined by Highways 15 (Utah) and 25 (Colorado) on the west and east, respectively, and Highway 70 on the north (Figure 9). Facilitating wolf dispersal through additional areas to the north of Highway 70 may be needed to achieve connectivity between wolf populations centered in the Grand Canyon and southern Colorado.

Habitat information relevant to eastern extent of recovery area

Approximately 24,000 km^2 of potentially suitable habitat (as based on the model of Carroll et al. [2006]) occurs in western Texas (Figure 12). This area is assessed as suitable in the model due to sufficient vegetation (and thus potential prey productivity) and low numbers of roads and human settlements. This area lies between the Davis Mountains and the Pecos River watershed in Jeff Davis, Brewster, Pecos, Terrell and Val Verde Counties, from approximately State Route 385 on the west to State Route 163 on the east. Public landholdings in this area are relatively small in size (e.g., the Davis Mountains State Park and Seminole Canyon State Park). Big Bend National Park, while large in size, lies to the south of this area and does not offer extensive suitable habitat due to its aridity. Conservation easements and private lands managed primarily for conservation total approximately 270 km^2 in the Davis Mountains.

Recovery plans for wide-ranging species typically assume that the primary responsibility for species conservation will fall on public lands, with additional activities occurring on private lands when these measures are also necessary for recovery. Due to the very low levels of public land ownership within otherwise suitable wolf habitat in Texas, the recovery team does not recommend that this area be considered as a primary reintroduction area. However, regulations limiting wolf mortality in this area (e.g., limitations on hunting of wolves) could allow a population of wolves to establish in this area due to natural dispersal from either the Blue Range or any wolf populations resulting from future reintroductions in the northern portion of Coahuila state (Mexico). However, the area of suitable habitat in Texas is somewhat isolated from these two areas as well as other potential wolf habitat in New Mexico. This isolation also reduces the role that Texas wolf populations could play in establishing a genetically secure Mexican wolf metapopulation.

Habitat information relevant to the U.S./Mexico Border Country and Mexico

Although habitat exists in the in the U.S./Mexico border area, the area would likely serve as a mortality sink for wolves (Carroll et al. 2005). The Service concluded that other than the BRWRA, other reintroduction sites in the border country were isolated and could each support only 5 to 30 wolves (U.S. Fish and Wildlife Service 1996). Such small populations are not viable without intensive prescriptive management and would resemble the one occupying Isle Royale National Park. Because of its small size and isolation (Peterson et al. 1998), the USFWS determined that the Isle Royale population has no relevance to gray wolf recovery in the Western Great Lakes states (U.S. Fish and Wildlife Service 1992, U.S. Fish and Wildlife Service 2011). It seems reasonable to conclude that small (e.g., 10-30 animals), isolated populations in the southwest will not contribute substantially to recovery of the Mexican wolf beyond their role in enhancing connectivity.

Preliminary habitat assessments suggest potential for restoring relatively small and isolated populations of Mexican wolves in Mexico (Figure 13). Previous efforts to compare habitat suitability and assess habitat connectivity between the U.S. and Mexico have been hampered due to differences in the resolution of landscape data from the two countries (Carroll et al. 2005). We are currently working to resolve these differences and complete an assessment of the distribution of suitable habitat in Mexico and the U.S. This material, which forms Section 1.f of the recovery plan, will be made available to the full recovery team at or prior to the next team meeting.

Recommended Mexican Wolf Recovery Area

Our review of relevant science and ESA-related policies prompts us to recommend a Mexican wolf recovery area that includes Mexico, extreme western Texas, Arizona, New Mexico, southern Utah (as circumscribed by interstate highways 15 and 70), and southern Colorado (as circumscribed by interstate highways 70 and 25) (Figure 9). This recommendation is endorsed by all but one member of the Science and Planning Subgroup of the Mexican Wolf Recovery Team.

The northern portion of our recommended Mexican wolf recovery area (i.e., those areas north of prior depictions of Mexican wolf historic range) derives from the explicit recognition by the Science and Planning Subgroup that:

- *baileyi's* current range differs from the most recently proposed historical range.
- suitable habitat is present.
- wolves may disperse to and inhabit the area due to the proximity and connectivity of habitat in southern Utah and Colorado to possible core reintroduction sites in central and northern Arizona and northern New Mexico.
- survival of individual wolves in the area and the connectivity of habitat will affect the ability of populations to achieve and maintain recovery criteria.

Inclusion of areas north of previously proposed historical ranges for the Mexican wolf is consistent with the conclusions on this matter reached by the IUCN Wolf Specialist Group and the IUCN Conservation Breeding Specialist Group and other experts involved in a comprehensive southern Rocky Mountains wolf population and habitat viability analysis.

The Mexican wolf recovery area that we recommend is similar to the area delineated for southwestern gray wolf distinct population segment (DPS) that was adopted by the USFWS in 2003 (Federal Register 68:15804-15875) (Figure 10). The science and planning subgroup of the team that was assembled to develop a recovery plan for the DPS concluded that *C. l. baileyi* was the most appropriate source stock for recovering the DPS (U.S. Fish and Wildlife Service 2003).

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