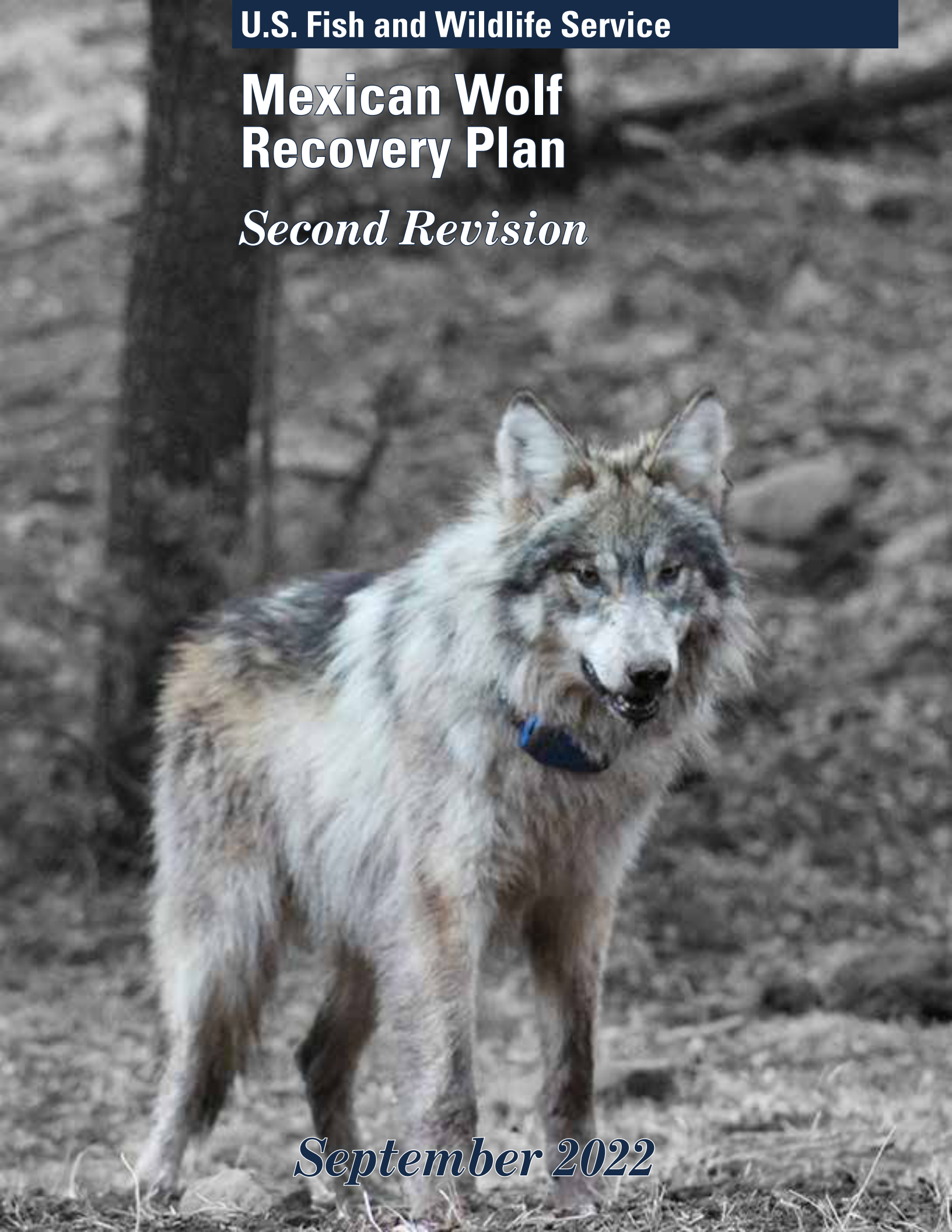
U.S. Fish and Wildlife Service

Mexican Wolf Recovery Plan

Second Revision



September 2022

MEXICAN WOLF RECOVERY PLAN

Second Revision

September 2022

Original Plan Approved: 1982
First Revision Approved: 2017

Southwest Region
U.S. Fish and Wildlife Service
Albuquerque, New Mexico

Approved: AMY LUEDERS Digitally signed by AMY LUEDERS Date: 2022.09.13 17:06:06 -06'00'

Regional Director, U.S. Fish and Wildlife Service, Southwest Region

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DISCLAIMER

The Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.), requires the development of recovery plans for listed species, unless such a plan would not promote the conservation of a particular species. In accordance with section 4(f)(1) of the ESA and to the maximum extent practicable, recovery plans delineate actions which the best available science indicates are required to recover and protect listed species. Plans are published by the U.S. Fish and Wildlife Service (Service), and are sometimes prepared with the assistance of recovery teams, contractors, state agencies, and others. Recovery teams serve as independent advisors to the Service. Plans are reviewed by the public and submitted to additional peer review before they are adopted by the Service. The purpose of a recovery plan is to provide a scientifically based, logical, and effective roadmap for the recovery of a species. It explains what is needed for species recovery and how to get there. Recovery plans are advisory documents, not regulatory documents. A recovery plan does not commit any entity to implement the recommended strategies or actions contained within it for a particular species, but rather provides guidance for ameliorating threats and implementing proactive conservation measures, as well as providing context for implementation of other sections of the Endangered Species Act, such as section 7(a)(2) consultations on Federal agency activities, development of Habitat Conservation Plans, or the creation of experimental populations under section 10(j). The recovery plan objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Nothing in this plan should be construed as a commitment or requirement that any Federal agency obligate or pay funds in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation. Recovery plans do not necessarily represent the views or the official positions or approval of any individuals or agencies involved in the plan formulation, other than the Service. They represent the official position of the Service once they have been signed by the Regional Director. Approved recovery plans are subject to modification as dictated by new information, changes in species status, and the completion of recovery actions. Please check for updates or revisions at the website below before using.

We developed the Mexican Wolf Recovery Plan, First Revision, in 2017 using a revised recovery planning process called Recovery Planning and Implementation (RPI), adopted by the Service in 2016. RPI is intended to reduce the time needed to develop recovery plans, increase the relevancy of recovery plans over a longer timeframe, and add flexibility to recovery plans so they can be adjusted to new information or circumstances. Under RPI, a recovery plan includes statutorily required elements (objective, measurable criteria; site-specific management actions; and estimates of time and costs), along with a concise introduction and explanation of our strategy to achieve species recovery. The RPI recovery plan is supported by a separate Species Status Assessment, or in some cases, such as with the Mexican wolf, a species Biological Report, which provides background, life-history, and threat assessment information. The biological report for the Mexican wolf is posted on our website https://www.fws.gov/southwest/es/mexicanwolf/. Additionally under RPI, we develop a separate working document called the Recovery Implementation Strategy (implementation strategy). The implementation strategy steps down from the more general description of actions described in the recovery plan to detail the near-term, specific activities needed to implement the recovery plan. The implementation strategy, which is also posted on our website, will be adaptable by incorporating new information as needed without revising the recovery plan, unless we need to change statutory elements.

Now, in response to a court-ordered remand of the Mexican Wolf Recovery Plan, First Revision, we have developed the Mexican Wolf Recovery Plan, Second Revision. This version of the recovery plan includes additional site-specific management actions to address the threat of human-caused mortality, including illegal killing, that the previous version of the recovery plan did not include. The addition of these site-specific management actions is responsive to the District Court of Arizona's October 14, 2021, ruling that the Mexican Wolf Recovery Plan, First Revision, did not contain site-specific management actions to address the recognized threat of illegal killing of Mexican wolves or explain why it would be impracticable or unnecessary to do so (*Center for Biological Diversity, et al., v. Haaland, et al.,* (Case No. 4:18-CV-00047-TUC-JGZ) (lead) and *WildEarth Guardians, et al., v. Haaland, et al.,* (Case No. 4:18-CV-00048-TUC-JGZ) (member). To incorporate the new recovery actions and their requisite time and cost estimates, we have updated the Implementation Schedule in Table 1 of this document; in addition, we provide the rationale for the newly added actions, as well as rationale for the revision of several existing recovery actions, in the subsection of the plan, **Recovery Actions Added to the Implementation Schedule to Address Human-Caused Mortality**.

ACKNOWLEDGEMENTS

A revision of the 1982 Mexican Wolf Recovery Plan has been a long time in coming, and we are grateful to the many people who have contributed their expertise, perspectives, and dedication to the Mexican wolf recovery effort over the last four decades. In particular, we would like to express our gratitude to our interagency and tribal partners and their staff; previous recovery team members and participants in recent recovery planning workshops; colleagues in Mexico; members of the Mexican Wolf Tribal Working Group; Species Survival Plan institutions, facilities, and staff; Service leaders and staff; the local communities in the Mexican wolf recovery area in the United States; and the general public. We have included a more extensive list of Acknowledgments in the Biological Report.

LITERATURE CITATION AND AVAILABILITY

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Copies are also available online at:
https://www.fws.gov/program/conserving-mexican-wolf

TABLE OF CONTENTS

DISCLAIMER i
LITERATURE CITATION AND AVAILABILITY iv
TABLE OF CONTENTS v
LIST OF FIGURES vii
LIST OF TABLES vii
EXECUTIVE SUMMARY 1
I. INTRODUCTION AND BACKGROUND 1
Recovery Planning 1
Recovery Implementation in the United States and Mexico 5
II. THREATS TO THE MEXICAN WOLF 10
III. RECOVERY STRATEGY 11
Geographic Distribution 12
Population Abundance 14
Genetic Management 14
Monitoring and Adaptive Management 16
Collaborative Recovery Implementation 17
IV. RECOVERY GOAL, OBJECTIVES, AND CRITERIA 19
Downlisting Recovery Criteria 19
Delisting Recovery Criteria 20
Rationale for Recovery Criteria 21
Resiliency 21
Representation 23
Redundancy 25
The Need for Regulatory Protection 25
Explanation of Downlisting Criteria 26
V. EVALUATION OF THE RECOVERY STRATEGY AND PROGRESS TOWARD RECOVERY 27
VI. ACTIONS NEEDED 29
Estimated Cost and Timing of Recovery 29
Acronyms Used In Recovery Action Table 30
Recovery Actions Added to the Implementation Schedule to Address Human-Caused Mortality 31
VII. LITERATURE CITED 45
VIII. APPENDIX: PUBLIC COMMENTS AND PEER REVIEW 47
Peer Review and Responses 47
Public Comments and Responses 48
Comments from State Agencies 49

Public Comments - Sources of Mortality and Management Responses 50
Public Comments - Education and Outreach 58
Public Comments - Law Enforcement 64
Public Comments - Miscellaneous 65

LIST OF FIGURES

Figure 1. Mexican Wolf Experimental Population Area in Arizona and New Mexico, United States (80 FR 2512, January 16, 2015). 7

Figure 2. Annual Minimum Population Count of Mexican Wolves in the MWEPA, 1998-2016 (U.S. Fish and Wildlife Service files). 8

Figure 3. Focal areas for Mexican wolf recovery in the United States and Mexico. (Habitat quality from Martínez-Meyer et al. 2017, titled "Figure 22. Rescaled intermediate habitat suitability scenario for the Mexican wolf based on the combination of climatic suitability, land cover use, human population density, road density, and UBI.") 13

LIST OF TABLES

Table 1. Recovery Action Table: Estimated Cost, Time, and Priority for Recovery Actions for the Mexican Wolf 36

EXECUTIVE SUMMARY

The Mexican wolf (*Canis lupus baileyi*) has been protected as an endangered subspecies of gray wolf since 1976 under the Endangered Species Act (ESA) of 1973, as amended (80 FR 2488). Following the near extinction of the Mexican wolf due to predator eradication efforts in the mid to late 1800s to mid-1900s, the U.S. Fish and Wildlife Service (Service, we), Mexico, and partner agencies initiated a binational captive breeding program descended from 7 founder wolves and began efforts to re-establish Mexican wolves in the wild in the United States in 1998 and Mexico in 2011.

Our recovery strategy for the Mexican wolf is to establish and maintain a minimum of two resilient, genetically diverse Mexican wolf populations distributed across ecologically and geographically diverse areas in the subspecies' range in the United States and Mexico. The recovery strategy for the Mexican wolf addresses the threats of human-caused mortality, extinction risk associated with small population size, and loss of gene diversity. Moreover, it ensures that Mexican wolf populations can achieve the *resiliency*, *representation*, and *redundancy* needed to downlist and delist the Mexican wolf, as described in the Rationale for Recovery Criteria. At the time of recovery, we expect Mexican wolf populations to be stable or increasing in abundance, well-distributed geographically within their range, and genetically diverse. The recovery strategy's primary components include expanding the geographic distribution of the Mexican wolf, increasing population abundance, improving gene diversity, monitoring wild populations and implementing adaptive management, and collaborating with partners to address social and economic concerns related to Mexican wolf recovery. We developed this binational Mexican wolf recovery strategy in coordination with federal agencies in Mexico and state, federal, and Tribal agencies in the United States.

Our recovery goal is to conserve and protect the Mexican wolf and its habitat so that its long-term survival is secured, populations are capable of enduring threats, and it can be removed from the list of threatened and endangered species. Recovery objectives for the Mexican wolf are:

1. Increase the size of two Mexican wolf populations;
2. Improve gene diversity and maintain the health of Mexican wolves;
3. Ensure adequate habitat availability to support viable Mexican wolf populations;
4. Maintain the Mexican Wolf Species Survival Plan (SSP) captive breeding program to improve the status of wild populations;
5. Promote Mexican wolf conservation through education and outreach programs; and
6. Ensure recovery success.

Downlisting Recovery Criteria

Option 1:

The Mexican wolf will be considered for downlisting when:

a) The United States population average over a 4-year period is greater than or equal to 320 Mexican wolves; and

b) Gene diversity available from the captive population has been incorporated in the United States population through the scheduled releases of wolves surviving to breeding age as identified in delisting criteria.

-or-

Option 2:

The Mexican wolf will be considered for downlisting when a minimum of two populations (one in the United States and one in Mexico) meet abundance and genetic criteria as follows:

a) Each population average over the same 4-year period is greater than or equal to 150 wolves with an annual positive population growth rate; and

b) Gene diversity available from the captive population has been incorporated into both the United States and Mexico populations through the scheduled releases of wolves surviving to breeding age as identified in delisting criteria.

Delisting Recovery Criteria

The Mexican wolf will be considered for delisting when:

1) A minimum of two populations meet all abundance and genetic criteria as follows:

United States

a) The population average over an 8-year period is greater than or equal to 320 wolves (e.g., annual wolf abundance of 200, 240, 288, 344, 412, 380, 355, and 342 averages 320 wolves);
b) The population must exceed 320 wolves each of the last 3 years of the 8-year period;
c) The annual population growth rate averaged over the 8-year period is stable or increasing (e.g., annual averages of 1.2, 1.2, 1.2, 1.2, 1.2, 0.9, 0.9, and 1.0 averages 1.1); and
d) Gene diversity available from the captive population has been incorporated into the United States population through scheduled releases of a sufficient number of wolves to result in 22 released Mexican wolves surviving to breeding age in the United States population. “Surviving to breeding age” means a pup that lives 2 years to the age of breeding or an adult or subadult that lives for a year following its release. “Scheduled releases” means captive releases and translocations that achieve genetic representation, as described in Rationale for Recovery Criteria.

Mexico

a) The population average over an 8-year period is greater than or equal to 200 wolves;
b) The population must exceed 200 wolves each of the last 3 years of the 8-year period;
c) The annual population growth rate averaged over the 8-year period is stable or increasing; and
d) Gene diversity available from the captive population has been incorporated into the Mexico population through scheduled releases of a sufficient number of wolves that

results in 37 released Mexican wolves surviving to breeding age in the Mexico population. "Surviving to breeding age" means a pup that lives 2 years to the age of breeding or an adult or subadult that lives for a year following its release. "Scheduled releases" means captive releases and translocations that achieve genetic representation, as described in Rationale for Recovery Criteria.

-and-

2) States and Tribes will ensure regulatory mechanisms are in place to prohibit or regulate human-caused mortality of Mexican wolves in those areas necessary for recovery such that the Service determines at least 320 Mexican wolves are likely to be maintained in the United States in the absence of Federal ESA protections. In addition, Mexico will ensure regulatory mechanisms are in place to protect Mexican wolves from human-caused mortality, such that the Service determines at least 200 Mexican wolves are likely to be maintained in Mexico.

To ensure we are making expeditious progress toward recovery, we will evaluate our progress at 5 and 10 years after implementation of the recovery plan and subsequently adjust our management as needed. The timing of the 5- and 10-year reviews is based on calendar years following the signing of the Mexican Wolf Recovery Plan, First Revision, in 2017. In addition, we will conduct 5-year species status reviews required under the Section 4(c)(2) of the ESA.

We developed recovery actions for the Mexican wolf for each objective, which include: surveying and monitoring Mexican wolf populations in the wild; conducting releases (including cross-fostering) and translocations of Mexican wolves; reducing human-caused mortality of Mexican wolves; reducing Mexican wolf-livestock conflicts; developing and implementing plans for releases, cross-fostering, and translocations; monitoring and managing Mexican wolf health and genetic health; maintaining habitat; maintaining and enhancing connectivity within and between Mexican wolf populations; maintaining and improving the status of native prey populations; managing the Mexican wolf captive breeding population; conducting education and outreach; managing the recovery program; coordinating binational recovery efforts; and developing adequate regulations and management and monitoring plans to maintain viable Mexican wolf populations after delisting. We added new site-specific management actions to this revised plan to address the threat of human-caused mortality in response to the court-ordered remand of the Mexican Wolf Recovery Plan, First Revision (2017).

We expect to recover the Mexican wolf within 25-35 years. The total estimated cost of implementing this plan through year 2043, the estimated recovery date of the Mexican wolf, is $202,959,000. The estimated cost to implement the first 5 years of recovery actions (i.e., intermediate steps toward the goal of recovery) is $41,585,000. This cost includes those borne by governmental agencies and nongovernmental organizations in the United States and Mexico.

I. INTRODUCTION AND BACKGROUND

The Mexican wolf, *Canis lupus baileyi*, has been protected as an endangered subspecies of gray wolf since 1976 under the Endangered Species Act (ESA) of 1973, as amended (80 FR 2488). The Mexican wolf is a top predator native to the southwestern United States and Mexico that lives in packs and requires large amounts of forested terrain with adequate ungulate (deer and elk) populations to support the pack. Predator eradication programs in the mid to late 1800s to mid-1900s resulted in the near extinction of the Mexican wolf. Extinction was averted with the initiation of a binational captive breeding population descended from seven Mexican wolf founders.

The United States Fish and Wildlife Service (Service, we) has been engaged in efforts to conserve and ensure the survival of the Mexican wolf for over three decades. Today, Mexican wolves again inhabit portions of the southwestern United States in Arizona and New Mexico, and the northern Sierra Madre Occidental of Chihuahua and Sonora in Mexico. Mexican wolves are present in these areas due to ongoing reintroduction efforts in both countries, supported by the binational captive breeding program. Additional information about the Mexican wolf reintroduction effort is available in the Biological Report for the Mexican Wolf (USFWS 2017a), and the following documents:

- Final Environmental Impact Statement for the Proposed Revision to the Regulations for the Nonessential Experimental Population of the Mexican wolf (*Canis lupus baileyi*) (USFWS 2014).
- Record of Decision (ROD) for the Proposed Revision to the Regulations for the Nonessential Experimental Population of the Mexican wolf (Canis lupus baileyi) (USFWS 2015).
- Revision to the Regulations for the Nonessential Experimental Population of the Mexican Wolf (80 FR 2512).
- Endangered and Threatened Wildlife and Plants; Endangered Status for the Mexican Wolf (80 FR 2488).
- Quarterly and annual reports
- 2022 Final Supplemental Environmental Impact Statement for the Proposed Revision to the Regulations for the Nonessential Experimental Populaiton of the Mexican Wolf (USFWS 2022) and ROD
- Endangered and Threated Wildlife and Plants; Revision to the Nonessential Experimental Population of the Mexican Wolf (87 FR 39348)
- Letter of Intent for the Conservation, Management, and Recovery of the Mexican Wolf

All documents are available online: https://www.fws.gov/program/conserving-mexican-wolf .

Recovery Planning
Four other recovery plans have been finalized for the Mexican wolf in the United States and Mexico:

- Mexican Wolf Recovery Plan, 1982 (USFWS 1982),

- Proyecto de Recuperación del Lobo Mexicano (PREP) (SEMARNAP 2000), and
- Programa de Acción para la Conservación de la Especie: Lobo Gris Mexicano (PACE) (CONANP 2009),
- Mexican Wolf Recovery Plan, First Revision, 2017 (USFWS 2017b)

The 1982 Mexican Wolf Recovery Plan was written by a recovery team established by the Service and signed by the Service and the Dirección General de la Fauna Silvestre in Mexico. The latter two plans were written under the guidance of the responsible federal agency in Mexico at the time (Secretaría de Medio Ambiente, Recursos Naturales y Pesca [SEMARNAP] and Comisión Nacional de Áreas Naturales Protegidas [CONANP]), in collaboration with the National Technical Advisory Subcommittee for the Recovery of the Mexican Wolf in Mexico. All three plans acknowledge the binational historical range of the Mexican wolf in the United States and Mexico, but each plan was written within the context of the federal laws governing its content. The 1982 Mexican Wolf Recovery Plan was written pursuant to the Service's obligation to develop recovery plans for species protected by the ESA, whereas the 2000 Proyecto de Recuperación was written pursuant to Mexico's Ley General del Equilibrio Ecológico y la Protección al Ambiente (or General Law for Ecological Balance and Environmental Protection) and the 2009 Programa de Acción was written pursuant to Mexico's Ley General de Vida Silvestre (or General Wildlife Law).

Mexico: Mexico's Proyecto de Recuperación was not required by law to set a numeric goal for recovery. The plan did, however, establish an objective to reach population levels that would ensure long-term viability by reintroducing Mexican wolves into several areas in Mexico (SEMARNAP 2000). The document explained that Mexico supported reintroduction on both sides of the Mexico-United States border and stated that it would be difficult to find appropriate habitat for reintroduction in Mexico. The Proyecto de Recuperación suggested that the best habitat may exist within the Sierra Madre Occidental and the Sierra Madre Oriental mountain ranges (SEMARNAP 2000).

The responsibilities for Mexico's priority species were transferred to CONANP in 2004, and the Programa de Acción was finalized in 2009 with the participation of the former technical advisory subcommittee. (The rule that established the National Technical Advisory Committee for Priority Species was abolished in March 2009, therefore, the subcommittee ceased to exist formally). This action plan established the necessary steps to begin the reintroduction of the Mexican wolf in Mexico, with five strategic goals: define at least six potential sites for Mexican wolf reintroduction; strengthen law enforcement actions to protect habitat within the historical range of the species; involve a variety of sectors of society in the recovery of the species; support the subcommittee's efforts for the reintroduction of the wolf; and create the conditions to allow the strategies of the subcommittee to contribute to the goals of the PACE (CONANP 2009). The action plan is considered to be outdated and in need of revision, but revision of these actions plans are not mandated on a specific schedule.

United States: The Service's 1982 Mexican Wolf Recovery Plan did not contain all three of the recovery plan elements specified in section 4(f)(1) of the ESA. At the time of writing, the recovery team could not foresee full recovery and eventual delisting of the Mexican wolf due to

its dire status in the wild and their assessment of a lack of suitable habitat within historical range due to human activities. Therefore, the recovery team stopped short of providing the objective and measurable recovery criteria required by the ESA and instead laid out a "prime objective":

> "To conserve and ensure the 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)."

The recovery actions and time and cost estimates in the 1982 Recovery Plan focused on information gathering and management recommendations in support of this prime objective. The Service initiated revisions of the 1982 Mexican Wolf Recovery Plan in the mid-1990s and early 2000s, but these revisions were not finalized due to many issues, including litigation related to gray wolf reclassifications (USFWS 2010). These efforts to revise the recovery plan focused on varying recovery areas. The 2003 effort focused on the southwestern distinct population segment (DPS) of the gray wolf (68 FR 15803); this DPS extended from Mexico to Interstate 70 in Colorado and Utah. A court vacated the rule that included the southwestern DPS designation, which halted this recovery planning effort (Defenders of Wildlife; et al., v. Secretary, United States Department of the Interior; et al., 354 F.Supp.2d 1156 (D. Or.2005).

We reinitiated recovery planning for the Mexican wolf again in 2010. This recovery planning effort was put on hold in 2013 while the Service focused on listing the Mexican wolf as an endangered subspecies and on developing revised regulations for the management of the experimental population of Mexican wolves within the Mexican Wolf Experimental Population Area (MWEPA). On June 13, 2013, the Service concurrently proposed a rule in the Federal Register to remove the gray wolf (*Canis lupus*) from the Federal List of Threatened and Endangered Species and list the Mexican wolf (*Canis lupus baileyi*) subspecies as endangered and expand recovery efforts in the Southwest (78 FR 35664). On January 16, 2015, the Service finalized a rule listing Mexican wolves as an endangered species, separate from the gray wolf (80 FR 2488) and revised the regulations for the nonessential experimental population of the Mexican wolf under section 10(j) of the ESA to improve the population's ability to contribute to recovery (80 FR 2512).

With the encouragement of the States and based on our collaborative relationship with Mexico, we reinitiated recovery planning in December 2015, focusing south of Interstate 40 in Arizona and New Mexico and into Mexico, which encompasses the historical range of the Mexican wolf (Parsons 1996). The Service convened six recovery planning workshops to review biological information that would inform the development of the recovery plan. The workshops were attended by staff from the States of Arizona, New Mexico, Colorado, and Utah; the U.S. Forest Service; and the Mexican government. In addition, the Service extended invitations to participate in these workshops to the scientists with experience related to wolf research that were on the Science and Planning Subgroup of the 2010 Mexican Wolf Recovery Team and to scientists who were recommended by the states and Mexico. The IUCN Conservation Planning Species Group facilitated the workshops and developed the Vortex Population Viability Analysis model. We also coordinated with Tribes and Pueblos on the development of this recovery plan through the Mexican Wolf Tribal Working Group. This group developed a Tribal Perspectives on Mexican

Wolf Recovery report (Mexican Wolf Tribal Working-Group 2017) that can be found online at https://www.fws.gov/program/conserving-mexican-wolf

In these workshops, participants reviewed the input parameters in the Vortex model, which helped inform the development of recovery criteria regarding the number of wolves, the number and genetic composition of populations, and connectivity needed to achieve recovery. Participants in the workshop modelled the amount of suitable habitat and prey available from the general vicinity of Interstate 40 south into the Sierra Madre Occidental and Sierra Madre Oriental in Mexico to determine where on the landscape Mexican wolf populations could be established and sustained. Based on these analyses, the Service and Mexico determined that there was sufficient habitat to allow for Mexican wolf recovery. However, due to uncertainty in achieving recovery, we included a periodic review process in the recovery plan to determine the effectiveness of Mexican wolf recovery efforts. If we are not achieving the expected level of recovery, we will revisit the recovery strategy and work with States and others to identify other areas with suitable habitat and adequate prey to achieve recovery; change techniques used to address gene diversity; or implement other substantive changes.

Mexican Wolf Recovery Plan, First Revision (2017)
The binational Mexican Wolf Recovery Plan, First Revision replaced and superseded the Service's 1982 Mexican Wolf Recovery Plan, but it did not replace, supersede, or otherwise affect Mexico's Proyecto de Recuperación and Programa de Acción. The Service recognized that the objectives of the 1982 Mexican Wolf Recovery Plan were largely to halt extinction and explore whether Mexican wolves could be reestablished in the wild. Together with our partners, we had achieved those objectives. The Mexican Wolf Recovery Plan, First Revision provided a strategy, criteria, and actions to recover the Mexican wolf pursuant to section 4(f)(1) of the the ESA:

i. a description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species;
ii. objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list; and
iii. estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal.

We developed the 2017 recovery plan using Mexican wolf monitoring data from the wild and captivity, data from other gray wolf populations when relevant, and other relevant scientific information. We also utilized two recent computer modeling analyses to develop the recovery strategy and criteria in this recovery plan. The first model analyzed population viability (referenced herein as population viability analysis or PVA [Miller 2017]). It used subspecies-specific data (e.g., pairing rates, survival rates, and models for number of detectable pups, and probability of producing a litter), some of which were not available for previous model evaluations (Carroll et al. 2014) to predict how a population will perform over time under different scenarios. The second model analyzed habitat suitability (referred to as habitat suitability analysis [Martínez-Meyer et al. 2017]). It used Geographic Information System data layers to identify variations in habitat quality across the landscape. These data and analyses are

provided in our Biological Report for the Mexican Wolf (referenced herein as the Biological Report [USFWS 2017a]). We will update the Biological Report as needed to maintain a compendium of the available scientific information upon which to base collaborative recovery efforts for the Mexican wolf (see Disclaimer for additional explanation of the Service's new Recovery Planning and Implementation process).

Mexican Wolf Recovery Plan, Second Revision (2022)
The Mexican Wolf Recovery Plan, Second Revision, maintains the recovery strategy, criteria, and actions from the previous version of the recovery plan but adds several site-specific management actions to address the threat of human-caused mortality, including illegal killing. We are maintaining the schedule established in the previous recovery plan to conduct evaluations of the recovery strategy and progress toward recovery at 5 and 10 years after implementation of the 2017 recovery plan began (see V. Evaluation of the Recovery Strategy and Progress Toward Recovery).

Recovery Implementation in the United States and Mexico
Recovery efforts for the Mexican wolf have been underway in the United States and Mexico for several decades. Working together, both countries are focused on maintaining the binational captive population of Mexican wolves and on re-establishing wild populations by releasing captive wolves into reintroduction areas and subsequently promoting natural growth of the populations.

Captive Breeding Program: The Mexican wolf captive breeding program was established in 1977 to 1980 with three effective founder wolves captured from the wild in Mexico. These founding wolves and their offspring were initially referred to as the Certified lineage, later renamed the McBride lineage (Parsons 1996). The captive breeding program has been managed pursuant to breeding protocols and genetic and demographic goals established by the Association of Zoos and Aquariums' Species Survival Plan since 1994 (Hedrick et al. 1997). Two additional lineages of Mexican wolves, the Ghost Ranch lineage, founded by two unrelated wolves, and the Aragon line, founded by two unrelated wolves, were maintained in captivity since the 1960s and 1970s, but were managed apart from the McBride lineage because of uncertainties about their origins. Through genetic analysis, the Ghost Ranch and Aragon lineages were confirmed to be pure Mexican wolves, and in 1995 they were integrated into the captive breeding program due to the limited genetic diversity of the captive population and the potential for inbreeding depression to hinder its success (Parsons 1996, Hedrick et al. 1997). The combination of the three lineages increased the founding base of the captive population from three to seven pure Mexican wolves (Hedrick et al. 1997).

Today, the binational captive breeding program continues to play a vital role in the conservation of the Mexican wolf by providing healthy wolves for release to the wild. However, the small number of founders of the captive population and the resultant low gene diversity available have been a concern since the beginning of the recovery program (Hedrick et al. 1997) and remain a concern today (Siminski and Spevak 2017, and see USFWS 2017a). Long-term viability or adaptive potential depends on the store of genetic variability. It is desirable to retain as much genetic variability as possible, and it is uncertain when loss of genetic variability might manifest in compromised reproductive function or physical and physiological abnormality (Soulé et al.

1986). As of July 2017, the binational captive program houses 281 wolves in 55 institutions, and has retained approximately 83% of the gene diversity of the founders, which is lower than the recommended retention of 90% for most captive breeding programs (Siminski and Spevak 2017, Soulé et al. 1986). It is expected that even with optimal management, the gene diversity in the captive population will continue to decline over time as wolves die or reach reproductive senescence. In its current condition, the population would be expected to retain 75% gene diversity over 67 years and 73% in 100 years (Siminski and Spevak 2017). The gene diversity of the captive population is higher than either wild population in the United States or Mexico. This is expected, as the wild populations are established utilizing animals that are genetically well represented within the captive population (Siminski and Spevak 2017) and because we are able to manage which wolves are paired each year for breeding in captivity, but it is more difficult to do so in the wild.

The United States and Mexico have each undertaken efforts to establish the Mexican wolf in the wild by releasing captive-bred wolves into areas of suitable habitat in each country. The United States and Mexico communicate their reintroduction plans with one another, share equipment, and transfer information and technology through staff visits to each country. Implementation of reintroductions occurs according to the legal frameworks and management provisions for each country.

United States Reintroductions: We began releasing Mexican wolves back into the wild in Arizona and New Mexico in 1998 in the MWEPA (USFWS 1998, 63 FR 1752). We revised this experimental population area in 2015 (Figure 1; 80 FR 2512). We, with our interagency partners, continue to manage Mexican wolves in this area pursuant to regulations under section 10(j) of the ESA that provide management flexibility and aid in the conservation and recovery of the Mexican wolf.

Figure 1. Mexican Wolf Experimental Population Area in Arizona and New Mexico, United States (80 FR 2512, January 16, 2015).

The Mexican wolf population in the United States has exhibited robust growth since 2009 (Figure 2). As of December 31, 2016, a population of at least 113 wild Mexican wolves inhabits the United States, the largest population size reached to date (USFWS 2017c). In 2016, all Mexican wolves in the United States were wild-born, with the exception of surviving cross-fostered pups from captivity (at least two surviving pups have been documented as of November 2017), demonstrating that population growth is driven by natural reproduction rather than the release of wolves from captivity. We conducted fourteen releases of wolves from captivity, including 10 cross-fostered pups, between 2009 and 2017, during which time the population grew from a minimum population count of 42 to 113 wolves. We have documented wild-born wolves breeding and raising pups in the wild for 16 consecutive years.

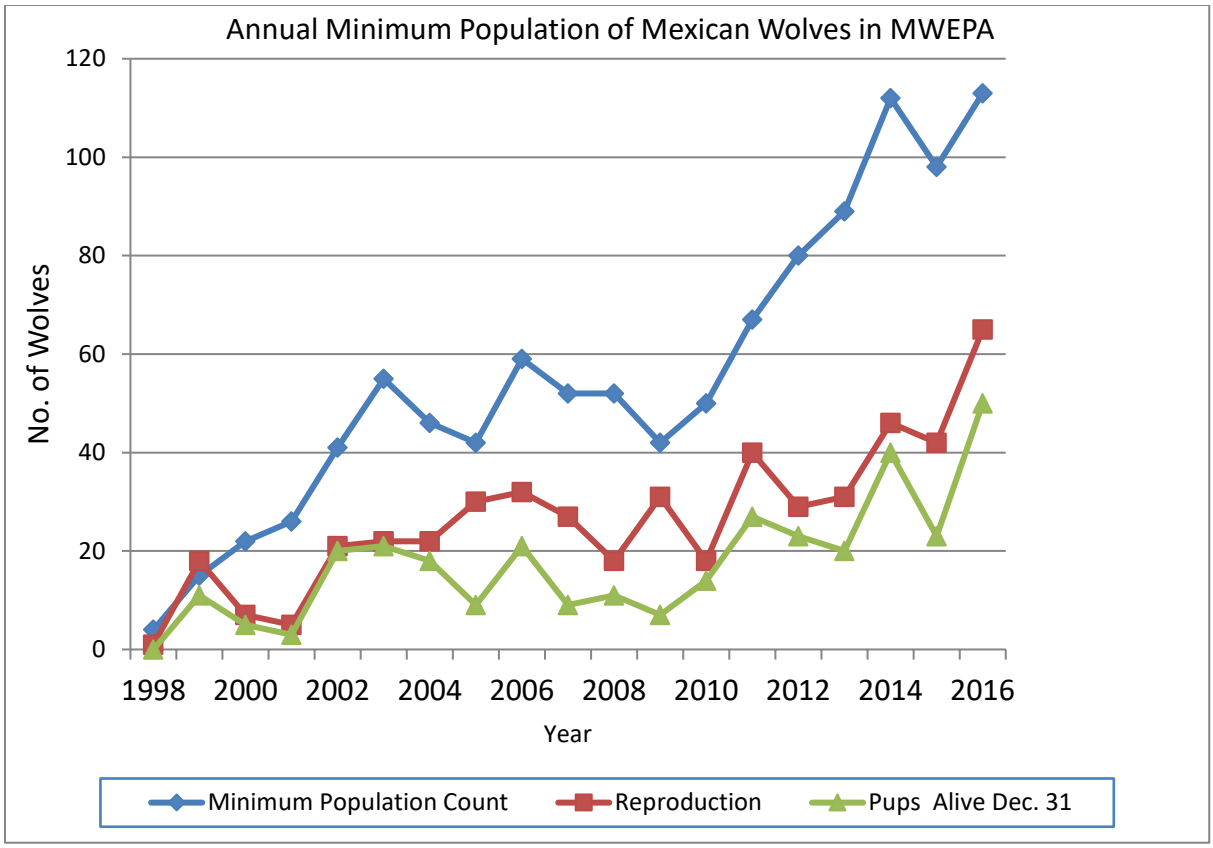

Figure 2. Annual Minimum Population Count of Mexican Wolves in the MWEPA, 1998-2016 (U.S. Fish and Wildlife Service files).

Although the population has been increasing since 2009, we consider Mexican wolves in the United States to be too closely related to one another (referred to as high mean kinship) to ensure the population will be robust over time. Mean kinship for the United States population is 0.2452 (Siminski and Spevak 2017). The high relatedness of wolves to one another and ongoing loss of gene diversity increases concerns over the potential for inbreeding depression to have negative impacts on future population growth in the United States (USFWS 2017a). Due to these concerns, the recovery plan focuses on inserting gene diversity into the United States population through the release of wolves from the captive population. Additionally, genetic diversity is required for populations to adapt to environmental change. We have documented that inbreeding depression is impacting the probability of a breeding pair producing a litter, but not to a degree that is hindering annual population growth in the United States population (USFWS 2017a, Miller 2017). Additional information about the status and trend of the United States population is available in our annual reports (online at https://www.fws.gov/southwest/es/mexicanwolf/documents.cfm) and the Biological Report for the Mexican Wolf, the latter of which also includes a more detailed discussion of the genetic condition of the United States population (USFWS 2017a, Miller 2017).

Mexico Reintroductions: Mexico began reintroducing Mexican wolves to the wild in 2011 and, as of 2017, is still in the establishment phase of their reintroduction effort. Forty-one wolves have been released in the first 5 years of the reintroduction, including both releases from

captivity and Mexican wolves translocated from the wild population in the United States to Mexico. As of July 2017, approximately 31 wild Mexican wolves inhabit Chihuahua and Sonora, Mexico, in the northern Sierra Madre Occidental (CONANP 2017, Garcia Chavez et al. 2017). Mexico is continuing to release captive or translocated Mexican wolves to help increase abundance until such time as natural reproduction is sufficient to sustain the population. One wild pair in Mexico has reproduced in three of its four years in the wild (USFWS 2017a), and their pups are successfully establishing wild packs with other released animals.

The focal areas for Mexican wolf recovery in the United States and northern Sierra Madre Occidental are approximately 260 miles (mi) (418 kilometers [km]) from each other (when measured from the center of one area to the other), a distance within the natural dispersal capabilities of the Mexican wolf. However, the distance between nearest high-quality habitat patches in both areas is approximately 96 mi (155 km). The proximity of these areas is such that Mexican wolves have the potential to move between populations depending on survival and how they are managed during dispersal events. Since reintroductions began, two Mexican wolves are known to have crossed the border from Mexico into the United States (USFWS files). Neither Mexican wolf became established in the United States: one returned to Mexico and one was captured and placed in captivity.

II. THREATS TO THE MEXICAN WOLF

We assess "threats" to a species during our determination of whether a species is threatened or endangered due to any of the five factors in the ESA:

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; and
E) other natural or manmade factors affecting its survival.

In our listing of the Mexican wolf as an endangered species, we conducted a detailed five-factor analysis of threats and determined that the Mexican wolf was in danger of extinction due to illegal shooting, genetic issues (inbreeding, loss of heterozygosity, and loss of adaptive potential), and small population size (80 FR 2488). In the Biological Report (USFWS 2017a), we provide an in-depth description of four "stressors" -- conditions that may influence the current and ongoing recovery potential of the Mexican wolf: 1) adequate habitat availability/suitability; 2) excessive human-caused mortality; 3) demographic stochasticity associated with small population size; and 4) continuing or accelerated loss of genetic diversity in the captive or wild populations. Stressors and threats are highly related concepts, but may not be one and the same for a species. For example, for the Mexican wolf, habitat destruction, modification, or curtailment (Factor A) is not threatening or endangering the Mexican wolf, yet ensuring adequate habitat is available to support recovered Mexican wolf population into the future is central to the recovery effort for the Mexican wolf (e.g., a potential stressor).

Within the context of the recovery plan, we consider the threats to the Mexican wolf to be excessive human-caused mortality (which includes shooting and other sources), demographic stochasticity associated with small population size, and loss of gene diversity. We provide discussion of each of these threats and the stressors noted above in the Biological Report (USFWS 2017a). We further address these threats in our Rationale for Recovery Criteria, and identify recovery actions to alleviate each threat.

III. RECOVERY STRATEGY

For any species, there may be several strategies that provide a valid path to recovery. This is the case for the Mexican wolf – different combinations of the location, number of populations, and number of wolves could alleviate the threats of human-caused mortality, lack of gene diversity, and extinction risk due to small population size. Our recovery strategy, which is based on the current status of the Mexican wolf in the wild and the threats it faces, is to establish and maintain a minimum of two resilient, genetically diverse Mexican wolf populations distributed across ecologically and geographically diverse areas in the subspecies' range in the United States and Mexico. Our recovery strategy addresses the threats of human-caused mortality, extinction risk associated with small population size, and loss of gene diversity (USFWS 2017a, Miller 2017). Moreover, it ensures that Mexican wolf populations can achieve the *resiliency*, *representation*, and *redundancy* needed to downlist and delist the Mexican wolf, as described in the Rationale for Recovery Criteria. At the time of recovery, we expect viable Mexican wolf populations that are stable or increasing in abundance, well-distributed geographically within their range, and genetically diverse.

We developed this binational recovery strategy for the Mexican wolf in coordination with federal agencies in Mexico and state, federal, and Tribal agencies in the United States. Management of listed species in areas outside of the United States is primarily the responsibility of the countries in which the species occur. However, partners in the United States and Mexico will cooperate to conserve and recover the Mexican wolf throughout its range.

The concepts of resiliency, redundancy, and representation are:

> *Resiliency* describes the ability of populations to withstand stochastic events. Measured by the size and growth rate of each population, resiliency is important because it gauges the probability that the populations comprising a species are able to withstand or bounce back from environmental or demographic stochastic events.
>
> *Redundancy* describes the ability of a species to withstand catastrophic events. Measured by the number of populations, their resiliency, and their distribution (and connectivity), redundancy is important because it gauges the probability that the species has a margin of safety to withstand or can bounce back from catastrophic events.
>
> *Representation* describes the ability of a species to adapt to changing environmental conditions. Measured by the breadth of genetic or environmental diversity within and among populations, representation is important because it gauges the probability that a species is capable of adapting to environmental changes.

The primary components of our recovery strategy include expanding the geographic distribution of the Mexican wolf, increasing population abundance, improving gene diversity in the wild, monitoring wild populations and implementing adaptive management, and collaborating with partners to address social and economic concerns related to Mexican wolf recovery.

Geographic Distribution

In the United States, we are focusing implementation of the recovery strategy for the Mexican wolf in the area south of Interstate 40 in Arizona and New Mexico. In Mexico, federal agencies are focusing Mexican wolf recovery efforts in the northern Sierra Madre Occidental in Chihuahua and Sonora (Figure 3).

Our strategy is to establish two populations over a large geographical area of the Mexican wolf's range to address the conservation principles of redundancy and representation (both ecological and geographical), as discussed in the Rationale for Recovery Criteria. We are focusing recovery implementation in the United States in the area south of Interstate 40, consistent with the range described by Parsons (1996), which the Service previously adopted when we began reintroducing wolves in 1998 (63 FR 1752). In Mexico, federal agencies are currently focusing Mexican wolf recovery efforts in the northern Sierra Madre Occidental (Figure 3). Recent habitat and population viability modeling (Martínez-Meyer et al. 2017, Miller 2017) support our geographic focus because they predict that each of these areas in the United States and Mexico can support a viable Mexican wolf population.

United States: Recovery in the United States will continue to focus on one large population of Mexican wolves south of Interstate 40 in Arizona and New Mexico. This area contains a large expanse of contiguous high-quality habitat along the Mogollon Rim in central Arizona into west central New Mexico, as well as other patches of high- and low-quality habitat (USFWS 2014; Martínez-Meyer et al. 2017). Management of Mexican wolves in this area is governed by the regulations for the nonessential experimental population of the Mexican wolf (80 FR 2512).

Mexico: In Mexico, there are two large blocks of high-quality habitat in the Sierra Madre Occidental that are connected by areas of lower quality habitat and small interstitial patches of high-quality habitat (Martínez-Meyer et al. 2017); we refer to these two areas as the northern Sierra Madre Occidental and southern Sierra Madre Occidental (Figure 3). Based on recent habitat modeling, we expect that either of these areas will be able to support a population of Mexican wolves (Martínez-Meyer et al. 2017). Current reintroduction efforts are focused in the northern Sierra Madre Occidental due to logistical considerations (e.g., monitoring wolves in a single area rather than spreading resources between the northern and southern areas), and therefore the recovery strategy in Mexico focuses on this area. However, if Mexican wolves disperse to southern Sierra Madre Occidental or federal agencies in Mexico decide to release Mexican wolves into this area as part of their reintroduction effort, the recovery strategy can be adapted to include wolves in either or both areas (Miller 2017). We have not identified large enough blocks of high-quality habitat in the Sierra Madre Oriental region to support a population of sufficient size to contribute to complete recovery under the ESA (Martínez-Meyer et al. 2017), although this does not preclude Mexico from pursuing reintroduction in this area pursuant to their laws and regulations.

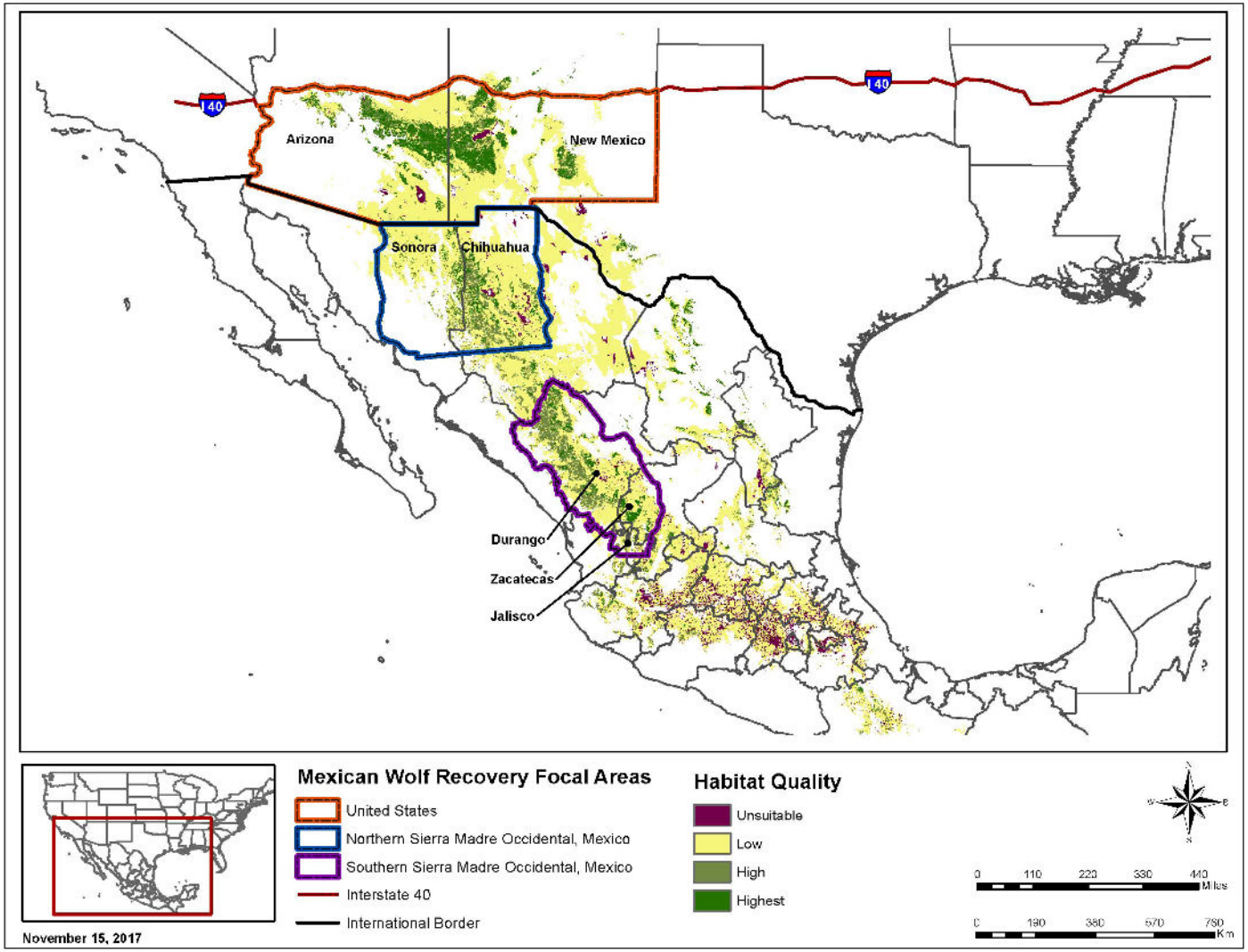

Figure 3. Focal areas for Mexican wolf recovery in the United States and Mexico. (Habitat quality from Martínez-Meyer et al. 2017, titled "Figure 22. Rescaled intermediate habitat suitability scenario for the Mexican wolf based on the combination of climatic suitability, land cover use, human population density, road density, and UBI.")

Population Abundance
We will increase the abundance of Mexican wolf populations in the United States and Mexico from their current size to an abundance that confers a low probability of extinction.

As population abundance increases, the threat of demographic stochasticity decreases and population resiliency increases (Goodman 1987; Pimm et al. 1988; and see discussion in USFWS 2017a; 80 FR 2488; and, USFWS 2010). Currently, both the United States and Mexico populations are at risk of extinction due to their small population size (USFWS 2017a, including Miller 2017). Therefore, both populations will need to increase in abundance sufficient to ameliorate this risk. We consider a population that has at least a 90% probability of persistence over 100 years to contribute to achieving recovery criteria, as described in our Rationale for Recovery Criteria. In the United States, population growth will likely continue to be driven primarily by natural reproduction. In the smaller Mexican wolf population in Mexico, population growth can be stimulated by the continued release of a substantial number of Mexican wolves from captivity to the wild, translocations, and population growth from natural reproduction increasing over time as more wolves become established in the wild.

Our strategy to establish populations of sufficient size to reduce extinction risk addresses the conservation principle of *resiliency*, as discussed further in the Rationale for Recovery Criteria.

Genetic Management
To improve gene diversity of Mexican wolf populations in the wild, we will release and translocate Mexican wolves, as needed.

As of June 2017, the captive population has higher gene diversity than either of the wild populations, and both wild populations are at risk of future genetic issues unless gene diversity can be improved (USFWS 2017a). The release of Mexican wolves from captivity to the wild can result in a substantial amount of the gene diversity available in captivity being represented in the wild. In this Plan, we aim to ensure wild populations represent approximately 90% of the gene diversity retained by the captive population to provide for *representation*. Release strategies from captivity may include the release of individual or paired adult wolves, a pack of wolves, or cross-fostering of pups. (Cross-fostering has been successful in other carnivores, but is a relatively new technique for Mexican wolves. Using this technique, we place captive-born pups into wild dens to be raised with the wild litter. We use this technique to improve the gene diversity of the wild population). Each of these release strategies has benefits and challenges that can be considered, in addition to new strategies that may arise in the future, within the opportunities and limitations of the release event and progress toward recovery. Translocation of wolves between wild populations can also be a source of gene diversity to the recipient population and will be considered as a way to improve the gene diversity of wild populations.

In order to achieve the genetic criteria for downlisting and delisting the Mexican wolf in this Plan, decisions regarding the timing, location and circumstances of Mexican wolf releases will be based on input from the Interagency Field Team, and will be made cooperatively by the Service with the Arizona Game and Fish Department with respect to releases in Arizona, and by the Service with the New Mexico Department of Game and Fish with respect to releases in New Mexico. Additionally, prior to any releases occurring, the Service will comply with state permit

requirements pursuant to (i) 43 C.F.R. pt. 24 and (ii) conditions imposed by any permit issued under section 10(a)(1)(A) of the Endangered Species Act, 16 U.S.C. 1539(a)(1)(A).

Released wolves (including both releases from captivity and translocated wolves) contribute their gene diversity to the recipient population when they breed and produce offspring. We will focus on the number of released wolves that survive to breeding age as our method of tracking progress toward achieving the gene diversity criterion, in concordance with Miller (2017). We estimate that an adult female of breeding age has a 78% likelihood of pairing with a male, and, once paired, has approximately a 68% likelihood of producing a litter, as a function of age and inbreeding (Miller 2017). Currently, many released wolves die within the first year of release, and released Mexican wolves in both wild populations have lower survival during that time than Mexican wolves born in the wild that are not associated with a release event (see Miller 2017 for data on release survival). The low survival of released wolves results in the need to release enough wolves that a sufficient number survive to breeding age. Management to improve the survival of released wolves will decrease the number of releases needed to achieve recovery criteria.

Our strategy to address the conservation principle of (genetic) representation, as discussed further in the Rationale for Recovery Criteria, is to release wolves from captivity to the wild and translocate wolves between populations to ensure wild populations benefit from the gene diversity available in the captive population. Population viability analysis by Miller (2017) has identified several combinations of releases and translocations that will achieve genetic *representation*, and we expect that other combinations are also possible.

The gene diversity of wild Mexican wolf populations can also be influenced through the dispersal of wolves from one wild population to another. We expect the patchy habitat in the border region of Mexico and the United States, as modeled by Martínez-Meyer et al. (2017), has the potential to support a low level of Mexican wolf dispersal between high-quality habitat patches in the United States and the northern Sierra Madre Occidental (about one wolf every 12-16 years; Miller 2017). As of 2017, the international border between the United States and Mexico has segments with no fence and with vehicle fence, both of which are permeable to wolves, as well as segments with pedestrian fence, which is not permeable to wolves (USFWS 2017a). Habitat quality between the northern and southern Sierra Madre Occidental sites in Mexico has the potential to support a higher degree of dispersal compared with the potential between the United States and northern Sierra Madre Occidental site, but it is still predicted to be low (about one wolf every 3-4 years; Miller 2017). While we anticipate habitat between any of the populations can support dispersing wolves and provide some connectivity, we do not expect the level of dispersal predicted between any of the sites (particularly between the United States and northern Sierra Madre Occidental) to provide for adequate gene flow between populations to alleviate genetic threats or ensure *representation* of the captive population's gene diversity in both populations. Therefore, we consider genetic management such as releases from captivity (including cross-fostering pups) and translocations to serve as an effective tool during the recovery process to achieve appropriate *representation* (Miller 2017). Thus, releases and translocations are a form of management that is necessary during portions of the recovery process. We do not expect regular releases from the captive population to be necessary after Mexican wolves have been recovered because a high proportion of the gene diversity from

captivity will have been incorporated into the wild populations and wild populations will be sufficiently abundant such that releases from captivity for population augmentation will not be necessary (Miller 2017). While releases and translocations are necessary for portions of the recovery process, we recognize the benefits of habitat connectivity and will work to maintain and enhance connectivity within and between Mexican wolf populations to improve gene diversity of Mexican wolves. We note, however, that connectivity or successful migrants are not required to achieve recovery (see addendum in Miller 2017).

Monitoring and Adaptive Management
We will conduct ongoing annual monitoring to track Mexican wolf population performance, and we will adjust management techniques and approaches as needed in response to population performance.

Our monitoring will continue to focus on annual population growth, recognizing the relationship between recruitment and mortality (i.e., high recruitment may offset high mortality rates). Wolf mortality, combined with removal of wolves for management purposes (which functions as mortality to the population), will need to stay below threshold levels such that populations can achieve abundance targets. The majority of documented mortalities in the United States are human-caused (USFWS 2017a); therefore, reducing mortalities from human-caused sources such as shooting and vehicle collision may provide our best opportunity to improve population performance and speed the time to recovery. Similarly, management removal of Mexican wolves in response to depredation incidents and conflict with humans has been the biggest source of removal and can impact population performance. Between 2003 and 2009, we observed the negative impact that a high number of removals can have on population performance in the United States, and in response, we reduced our removal rate by focusing on working with landowners and permittees to implement proactive management techniques such as range riders, fladry, non-lethal ammunitions, and diversionary feeding to decrease the likelihood of depredation incidents. Diversionary food caches are road-killed native prey carcasses or carnivore logs (commercially manufactured raw horse meat-based diet especially formulated for carnivores) provided to denning wolves to reduce potential conflicts with livestock in the area.

In the United States, our recovery strategy will entail adaptively managing our removal rate of Mexican wolves in response to documented mortality during the previous year to ensure that mortality is not hindering population growth over multiple years. Therefore, we will employ management actions to work to reduce wolf-livestock and wolf-human conflict through the implementation of pro-active measures to avoid and minimize depredation; facilitate the provision of compensation for the economic impact of wolves on rural ranching communities; and employ a phased management approach in Arizona to minimize or avoid possible adverse impacts to wild ungulate populations (specifically elk). We will also allow take of Mexican wolves under specific circumstances, and continue to work collaboratively with state and local governments, tribes, livestock producers, state game and fish departments, and stakeholder organizations to achieve the social tolerance for wolves in rural communities necessary to achieve Mexican wolf recovery. We expect that Mexico will conduct similar monitoring of Mexican wolves to track population performance and adapt management strategies as needed.

Monitoring of wild Mexican wolf populations will help us annually track our progress in achieving the *resiliency*, *representation*, and *redundancy* necessary for recovery. In addition, we have provided evaluation periods at 5 and 10 years after we begin implementing the recovery plan to evaluate whether the recovery strategy is effective and progress toward recovery is occurring as predicted.

Collaborative Recovery Implementation
We will continue to work with partners to identify and implement effective recovery actions necessary to recover the Mexican wolf and address conflicts related to Mexican wolf recovery in local communities.

The recovery of the Mexican wolf has been a collaborative effort since its earliest days. Effective recovery requires participation by multiple parties within Federal, state, and local governments; nongovernmental organizations; academia; and local communities. We have strong partnerships with the Species Survival Plan captive breeding facilities in the United States and Mexico. We also collaborate with Federal, state, county, and Tribal agencies through a Memorandum of Understanding and the establishment of the Mexican Wolf Interagency Field Team, which conducts the reintroduction, management, and monitoring of Mexican wolves in the United States. We intend to maintain and strengthen the interagency partnerships currently in place for the United States population.

Section 6 (a) of the ESA directs the Service to cooperate to the maximum extent practicable with the states (59 FR 34275), and Secretarial Orders 3175 and 3206 and the Service's Native American Policy (2016) require consultation with tribes in the recovery of listed species. Opportunities for increasing levels of state and tribal management are currently available under the 10(j) rule and will continue to be explored as recovery progresses. When the status of the Mexican wolf has improved sufficiently to downlist it to threatened, we may consider establishing a 4(d) rule under the ESA. The Service uses 4(d) rules to incentivize positive conservation actions and streamline the regulatory process for minor impacts. As part of those goals, the rule is often used to clarify or simplify what forms of take of a threatened species are/are not prohibited wherever the animals may occur. Establishment of a 4(d) rule after the status of the Mexican wolf has improved to "threatened" would provide the state wildlife agencies increased management flexibility. The Service would first publish a proposed rule in the Federal Register and seek public comment and peer review before making a decision on the action.

Addressing wolf-livestock conflicts is one of the most important areas for collaborative management of Mexican wolves. Depredation compensation is currently available through:

- the Farm Bill Livestock Indemnity Program, which is administered by the Farm Services Agency (see https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/livestock-indemnity/index);
- the Arizona Livestock Loss Board (see https://www.azgfd.com/Agency/LivestockBoard/; and
- the Mexican Wolf/Livestock Council (see https://www.fws.gov/program/conserving-mexican-wolf).

The Mexican Wolf/Livestock Council is an 11-member group of livestock producers, Tribes, county representatives, and environmental groups appointed by the Service. The Service will continue seeking additional funding for these programs to offset Mexican wolves' direct and indirect costs to livestock producers.

Due to the binational range of the Mexican wolf, successful recovery of the species requires close coordination and cooperation with recovery partners in Mexico. The Service has a strong working relationship with the Mexican governmental agencies CONANP and Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT), as well as field staff working to reestablish the Mexican wolf in the wild in Mexico. Section 8 (b) of the ESA encourages foreign countries to provide for the conservation of threatened and endangered species, and the Service to enter into agreements with foreign countries to provide for such conservation. Our relationship with the Mexican government is formalized through a 1996 Memorandum of Understanding establishing the Canada/Mexico/United States Trilateral Committee for Wildlife and Ecosystem Conservation and Management. The Service and our state partners will continue to seek funding to assist Mexico in implementing actions necessary to achieve Mexican wolf recovery. In addition, the Service and our partners will continue to exchange technology and expertise with Mexico to implement recovery actions.

IV. RECOVERY GOAL, OBJECTIVES, AND CRITERIA

Recovery Goal:
The recovery goal is to conserve and protect the Mexican wolf and its habitat so that its long-term survival is secured, populations are capable of enduring threats, and it can be removed from the list of threatened and endangered species.

Recovery Objectives:
Recovery objectives identify outcomes that will lead to achieving the goal of recovery and delisting. Recovery objectives for the Mexican wolf are:

1. Increase the size of two Mexican wolf populations;
2. Improve gene diversity and maintain the health of Mexican wolves;
3. Ensure adequate habitat availability to support viable Mexican wolf populations;
4. Maintain the Mexican Wolf Species Survival Plan (SSP) captive breeding program to improve the status of wild populations;
5. Promote Mexican wolf conservation through education and outreach programs; and
6. Ensure recovery success.

Recovery Criteria:
Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or that the protections afforded by the ESA are no longer necessary and the Mexican wolf may be delisted. Delisting is the removal of a species from the Federal Lists of Endangered and Threatened Wildlife and Plants. Downlisting is the reclassification of a species from Endangered to Threatened. The term "endangered species" means any species (species, sub-species, or DPS) which is in danger of extinction throughout all or a significant portion of its range. The term "threatened species" means any species which is likely to become an endangered species within the foreseeable future throughout all or a signification portion of its range.

All classification decisions consider the following five factors: 1) is there a present or threatened destruction, modification, or curtailment of the species' habitat or range; 2) is the species subject to overutilization for commercial, recreational scientific or educational purposes; 3) is disease or predation a factor; 4) are there inadequate existing regulatory mechanisms in place outside the ESA (taking into account the efforts by the states and other organizations to protect the species or habitat; and 5) are other natural or manmade factors affecting its continued existence. When delisting or downlisting a species, we first propose the action in the *Federal Register* and seek public comment and peer review. Our final decision is announced in the *Federal Register*.

We provide both downlisting and delisting criteria for the Mexican wolf as follows:

Downlisting Recovery Criteria

Option 1:

The Mexican wolf will be considered for downlisting when:

a) The United States population average over a 4-year period is greater than or equal to 320 Mexican wolves; and
b) Gene diversity available from the captive population has been incorporated in the United States population through the scheduled releases of wolves surviving to breeding age as identified in delisting criteria.

-or-

Option 2:

The Mexican wolf will be considered for downlisting when a minimum of two populations (one in the United States and one in Mexico) meet abundance and genetic criteria as follows:

a) Each population average over the same 4-year period is greater than or equal to 150 wolves with an annual positive population growth rate; and
b) Gene diversity available from the captive population has been incorporated into both the United States and Mexico populations through the scheduled releases of wolves surviving to breeding age as identified in delisting criteria.

Delisting Recovery Criteria

The Mexican wolf will be considered for delisting when:

1. A minimum of two populations meet all abundance and genetic criteria as follows:

United States

a) The population average over an 8-year period is greater than or equal to 320 wolves (e.g., annual wolf abundance of 200, 240, 288, 344, 412, 380, 355, and 342 averages 320 wolves);
b) The population must exceed 320 wolves each of the last 3 years of the 8-year period;
c) The annual population growth rate averaged over the 8-year period is stable or increasing (e.g., annual averages of 1.2, 1.2, 1.2, 1.2, 1.2, 0.9, 0.9, and 1.0 averages 1.1); and
d) Gene diversity available from the captive population has been incorporated into the United States population through scheduled releases of a sufficient number of wolves to result in 22 released Mexican wolves surviving to breeding age in the United States population. “Surviving to breeding age” means a pup that lives 2 years to the age of breeding or an adult or subadult that lives for a year following its release. “Scheduled releases” means captive releases and translocations that achieve genetic representation, as described in Rationale for Recovery Criteria.

Mexico

a) The population average over an 8-year period is greater than or equal to 200 wolves;
b) The population must exceed 200 wolves each of the last 3 years of the 8-year period;

c) The annual population growth rate averaged over the 8-year period is stable or increasing; and
d) Gene diversity available from the captive population has been incorporated into the Mexico population through scheduled releases of a sufficient number of wolves that results in 37 released Mexican wolves surviving to breeding age in the Mexico population. "Surviving to breeding age" means a pup that lives 2 years to the age of breeding or an adult or subadult that lives for a year following its release. "Scheduled releases" means captive releases and translocations that achieve genetic representation, as described in Rationale for Recovery Criteria.

-and-

2. States and Tribes will ensure regulatory mechanisms are in place to prohibit or regulate human-caused mortality of Mexican wolves in those areas necessary for recovery such that the Service determines at least 320 Mexican wolves are likely to be maintained in the United States in the absence of Federal ESA protections. In addition, Mexico will ensure regulatory mechanisms are in place to protect Mexican wolves from human-caused mortality, such that the Service determines at least 200 Mexican wolves are likely to be maintained in Mexico.

Rationale for Recovery Criteria

Resiliency

The abundance criteria ensure that populations are *resilient* and the threats of demographic stochasticity and human-caused mortality have been ameliorated. We consider a *resilient* population to be one that is able to maintain at least a 90% likelihood of persistence over a 100-year period. This benchmark falls within the community of practice of recent recovery plans assessed by Doak et al. (2015). In addition, we consider a population to be *resilient* when it has an average annual growth rate that is stable or increasing (i.e., lambda ≥ 1) over the 8-year timeframe and is above its abundance criterion in years 6, 7, and 8. At this level of *resiliency*, the threat of demographic stochasticity has been ameliorated because the population is secure from random population fluctuations, and mortality rates are sufficiently low to allow for stable, long-term persistence of the populations (USFWS 2017a).

Based on population viability modeling, we predict the United States and Mexico populations will achieve *resiliency* when an average population of 320 and 200 Mexican wolves, respectively, can be maintained for 8 years (Miller 2017). Establishing a criterion for an average abundance means that in some years the populations may exceed abundance targets (320 and 200, respectively for the United States and Mexico populations), while in some years they may fall below their target; this is consistent with the annual population fluctuations predicted by population viability modeling results (Miller 2017). Years in which the population grows above 320 are expected and will enable progress toward the abundance criterion for the United States population more quickly than when the population hovers at or near 320.

Mortality rates will need to be sufficiently low to achieve recovery criteria because they are a primary indicator of wolf population trajectory (Fuller et al. 2003). Previous gray wolf studies have primarily pooled mortality rates across age classes for pups older than approximately 6 months, yearlings, and adults (Fuller et al. 2003, Adams et al. 2008). Miller's (2017) results

were based on estimated mortality rates for Mexican wolves in each of the three age classes. Thus, Miller (2017) results are not necessarily directly comparable to other studies. Miller (2017) scenarios with mean adult mortality rates less than 25%, combined with mean sub-adult mortality rates less than 33% and mean pup mortality (for radio-marked pups greater than 4 months old) less than 13% resulted in an increasing population that meet the population abundance recovery criteria, under certain management regimes. In agreement with the results of Carroll et al. (2014), population performance in Miller's results was highly sensitive to relatively small changes in adult mortality rate. Miller's results are consistent with meta-analyses that suggest a wolf population should stabilize with an overall average mortality rate of 34% (Fuller et al. 2003). Miller's results indicate the populations need to perform at mortality rates lower than Fuller et al. (2003) because: (1) the Mexican wolf population needs to exhibit growth (rather than stability) to achieve recovery, (2) the results are based on specific characteristics of the Mexican wolf population rather than wolves in general, and (3) other studies of wolf population growth are significantly influenced by immigration and emigration (Adams et al. 2008), and we do not predict significant natural rates of immigration or emigration between the Mexican wolf populations (Miller 2017). Miller's results are also consistent with growing wolf populations in central Idaho and the Greater Yellowstone area (Smith et al. 2010). The mean mortality rate utilized for Miller's results incorporates human-caused mortality and demonstrates that Mexican wolf populations will still be stable or increasing.

We consider an acceptable mortality rate during the recovery process to be one where the population grows toward or is maintained at the desired population abundance. Thus, the average mortality rates could change over time based on management goals and additional data. We expect to adaptively manage the population to reduce or increase removals based on documented mortality from other causes during the previous year to ensure that the mean mortality rate over several years does not exceed those identified by Miller (2017).

Miller (2017) suggests there is a functional relationship between the inclusion of diversionary feeding and the number of pups produced in that population. Therefore, removal of diversionary feeding can lead to a decrease in the population growth rate for a given level of annual adult mortality. Miller (2017) evaluated the impact of removing diversionary feeding for both the United States and Mexico populations in a select set of PVA scenarios. The results of these analyses indicate that reducing adult mortality is necessary when diversionary feeding is significantly reduced or eliminated (see Addendum in Miller 2017). However, we expect to continue a low level of diversionary feeding to reduce conflicts between livestock and wolf packs rearing pups.

To ensure populations have a high likelihood of maintaining *resiliency*, they must meet the average population abundance targets for 8 consecutive years. Eight years provides an appropriate amount of time to observe the populations' demographic performance for several reasons. First, an 8- year window is equivalent to approximately two wolf generations, grounding the criteria in a biologically relevant timeframe. Observing the population for longer than a single generation will provide assurance that population metrics such as reproduction and mortality rates are fluctuating within expected levels at the target abundance and that populations are performing such that recovered status is likely to be maintained after delisting. Specifically, it allows us to observe population trend, which we expect to be stable or growing as populations

achieve recovery, although we also expect annual fluctuations could include population declines for one or a few years during an 8-year period. We estimate that an 8-year period will include one catastrophe cycle (i.e., an event of extreme pup mortality, as described in Miller 2017), allowing us to ensure that the population is able to rebound following such an event. Downlisting criteria require only a single generation (4 years) because protections under threatened status would remain in place to ensure that populations remain robust through various population cycles. We would not downlist or delist the Mexican wolf if population performance demonstrates that wolf populations are unstable (e.g., populations have not rebounded from a catastrophe cycle).

Based on Miller (2017), we predict that recovery could be reached within 25-35 years (i.e., about 2043 to 2053). This includes the time to reach the abundance and genetics targets in both countries and achieve the population averages indicated in the criteria. However, recovery could be reached sooner if populations grow more rapidly than predicted (e.g., through lower mortality rates, higher recruitment). Also based on Miller (2017), we predict downlisting could be possible within approximately 16-20 years (i.e., about 2034 to 2038) (Miller 2017). Similarly, downlisting could be reached sooner with more rapid population growth. Miller's results are useful for estimating the time frame to recovery assuming the conditions specified in the population viability model are similar (which we expect) to those observed in the wild during recovery implementation.

In the United States, we will focus our management to ensure a population of at least 320 Mexican wolves can be maintained. We recognize that unrestricted Mexican wolf population growth may erode social tolerance in local communities or cause other management concerns, such as unacceptable impacts to wild ungulates (USFWS 2014). We consider it not only possible, but preferable, to achieve recovery while addressing the concerns of local communities and economies. Therefore, we used the Vortex model to explore viability of populations that were not allowed to increase over 380 Mexican wolves in the United States to simulate management response to problem wolves and unacceptable impacts to native ungulate herds (Miller 2017). While 380 Mexican wolves functioned as a population cap in the model, it was not intended as a limit on the number of Mexican wolves in the wild. However, if population growth is causing management concerns, we will consider any and all management options, including allowing mortality rates to increase through permitted take or other mechanisms, provided at least 320 Mexican wolves are likely to be maintained.

Representation

The gene diversity criterion ensures that Mexican wolf populations have genetic *representation* and that genetic threats have been ameliorated, while having Mexican wolves across large portions of their range ensures ecological *representation*. Ensuring gene diversity in the near term will reduce the incidence of inbreeding depression, while over a longer timeframe it will aid the Mexican wolf's ability to respond and adapt to various and changing environmental conditions.

We consider the degree to which wild populations contain the gene diversity (expected heterozygosity) available from the captive population to be an important indication of genetic *representation* for recovery (USFWS 2017a). Ensuring wild populations represent approximately

90% of the gene diversity retained by the captive population provides for *representation* based on community of practice in the management of captive populations (Siminski and Spevak 2017). Typically when captive populations are established from wild populations, the goal is to retain at least 90% of the gene diversity available from the wild population (Soulé et al. 1986). In the case of the Mexican wolf, we are applying this goal to establish a wild population from a captive population. We consider approximately 90% to be reasonable for recovery because it ensures wild populations contain a high degree of the gene diversity available (Siminski and Spevak 2017), while recognizing that we cannot control breeding events in the wild and need flexibility in our management of wolves (e.g., removal of Mexican wolves from the wild for management purposes may positively or negatively affect the gene diversity of the population). Miller (2017) identifies several release scenarios that are able to achieve 90% gene diversity of the captive population in the wild by model year 20 (2035). It is important to note that in the scenarios presented by Miller (2017), not all released wolves incorporated into the population contribute offspring, and conversely, some released wolves incorporated into the wild population will contribute offspring more than once. We would expect to use one of these release scenarios or a comparable scenario to meet the scheduled releases necessary to achieve the recovery criteria.

Release strategies from captivity may include the release of individual or paired adult wolves, a pack of wolves, or cross-fostering of pups. The importance of the releases of Mexican wolves from the captive population into the wild is demonstrated graphically in the PVA report (Miller 2017). Based on the current estimates of first year mortality of wolves released from captivity, we estimate the need to release about 70 wolves to the United States population to have 22 of them survive to breeding age. We estimate the need to release about 100 wolves to the wild population in Mexico to have 37 of them survive to breeding age. The number of releases required may increase or decrease if the survival of released wolves changes. We did not require that a released or translocated wolf survive and produce offspring in the population, as the basis for recovery criteria. We instead used a metric (i.e., number of animals that survive to breeding age) that coupled model performance with performance of the wild populations. Including a low level of dispersal/connectivity (approximately 1 wolf every 12 to 16 years), the model predicts that at this level of release and at the predicted first year mortality rate we will achieve gene diversity in the wild population of approximately 90% of that retained in the captive population (Miller 2017).

The extent to which released Mexican wolves are able to influence the gene diversity of a wild population is a function of the number of released wolves that survive and breed in relation to the recipient population abundance (i.e., when releases represent a larger proportion of the recipient population, they result in greater genetic and demographic effect). Therefore, the timing of releases of wolves in relation to population size and whether or not they survive to breeding age are critical factors in the degree to which releases will ensure that approximately 90% of the gene diversity available in captivity is represented in each wild population. For this reason, it will be important for us to establish a schedule of releases that achieves the recovery criteria (Actions 2.1, 2.2, and 2.3 in Table 1).

We consider all releases subsequent to December 2015 to contribute to the genetic criteria for the United States and all releases subsequent to December 2016 to contribute to the genetic criteria

for Mexico. These are appropriate starting dates because Miller's (2017) scenarios were initiated with the pedigree of both populations as of December 2015, but Mexico's 2016 releases were included in the first time step of the model due to the large number of releases that year and the resultant effect on the population's genetic and demographic condition.

We will achieve ecological *representation* by the distribution of Mexican wolves across large portions of their historical range (per Parsons 1996) in the United States and Mexico, namely within Arizona and New Mexico south of Interstate 40 and in the northern Sierra Madre Occidental. Martínez-Meyer et al. (2017) estimate 44,477 km^2 (17,173 mi^2) of high quality habitat in Arizona and New Mexico south of Interstate 40, 21,538 km^2 (8,316 mi^2) in the northern Sierra Madre Occidental, and 34,540 km^2 (13,339 mi^2) in the southern Sierra Madre Occidental under the intermediate scenario with ungulate biomass index. Habitat conditions vary between the United States and Sierra Madre Occidental sites in both terrain and vegetation, as well as the abundance and distribution of prey (USFWS 2017a). These differences will expose the Mexican wolf genome to different environments that may result in different selection pressures. We anticipate more genetically diverse wild populations in the United States and northern Sierra Madre Occidental will be better able to respond to not only the current range of habitat conditions, but also future changing conditions such as shifts in prey availability, drought, or other environmental fluctuations. Variation in environmental conditions (such as drought, fire, and prey fluctuations) and episodic threats, such as disease, are characteristic of wild populations of most species, including Mexican wolves. Mexican wolf populations that are genetically robust will be more likely to recover from episodic threats (USFWS 2010). While we do not consider climate change to be a threat to the Mexican wolf (see our discussion at 80 FR 2488), we recognize that climatic conditions are changing and may consider establishing populations with genetic representation in ecologically/geographically varied habitat to provide Mexican wolves with the potential to withstand these changes.

Redundancy

The establishment of two resilient populations of Mexican wolves with genetic and ecological representation provides for *redundancy* (USFWS 2017a). *Redundancy* provides for security against extinction from catastrophic events that could impact a single population by ensuring that one or more additional resilient, representative populations persist. Our recovery criteria require a minimum of two demographically and environmentally independent populations (e.g., limited dispersal) such that negative events (e.g., disease, severe weather, natural disasters) are unlikely to affect both populations simultaneously (Allendorf and Luikart 2007). In addition, both populations are independently resilient and could be used as a source for reestablishment if severe catastrophes were to occur in a single population. As modeled by Martínez-Meyer et al. (2017), within the historical range of the Mexican wolf (Parsons 1996) there are areas of high-quality habitat in Mexico and the United States of sufficient size to establish *redundant* populations that are resilient.

The Need for Regulatory Protection

Prior to delisting, we will ensure that the state and tribal agencies that will be responsible for maintaining the recovered status of the Mexican wolf have adequate regulations in place to ensure levels of human-caused mortality will enable the population to retain the population abundance specified by the abundance criterion in the United States. We will collaborate with

these agencies during the implementation of the recovery plan as needed to prepare for a change in management from federal to state and tribal regulatory control of the Mexican wolf. Additionally, Mexico will also ensure that regulations are in place to manage levels of human-caused mortality to enable the population to retain the population abundance specified by the abundance criterion in Mexico.

Explanation of Downlisting Criteria

The downlisting criteria are intended to demonstrate that the status of the Mexican wolf has improved such that it is no longer endangered. We provide two options for downlisting the Mexican wolf to threatened status: the United States population achieves abundance and genetic criteria but Mexico does not, or both populations reach a partial level of genetic and demographic stability, but neither population has fully reached its desired population abundance target.

The first option for downlisting is appropriate if the United States population has achieved the abundance criterion for 4 (one wolf generation) of the 8 years, and releases of wolves to provide gene diversity (*representation*) have been conducted. This population will be close to achieving *resiliency* and will have achieved *representation*, but the *redundancy* provided by the second population will not yet be achieved.

The second option (i.e., both populations reach an average population abundance of 150 for 4 years, and releases of wolves to provide gene diversity have been conducted) demonstrates that progress toward *redundancy* is substantial and *representation* has been achieved. In this situation, neither population's abundance is sufficient to achieve *resiliency*, but both would be on track to becoming resilient given their annual positive growth rate. The criterion of 150 Mexican wolves is not intended as a proportion of the population abundance required for delisting, but rather is an indicator of a population abundance that confers a level of genetic and demographic stability (i.e., low extinction risk) under assumed rates of population growth. Given the predicted level of genetic and demographic stability, the Mexican wolf would no longer be in danger of extinction throughout all or a significant portion of its range (i.e., endangered).

As recovery of the Mexican wolf progresses, including but not limited to downlisting to threatened status, we will explore management options with the states and tribes in the United States to increase management flexibility and foster the conservation of the Mexican wolf, as discussed in the Recovery Strategy.

V. EVALUATION OF THE RECOVERY STRATEGY AND PROGRESS TOWARD RECOVERY

Due to the intensive logistical, economic, and socio-political nature of the Mexican wolf recovery effort, it is critical to ensure that progress toward recovery is advancing in a timely manner. Therefore, to determine whether the recovery strategy is proving effective, we will evaluate its efficacy and the progress of the Mexican wolf population toward recovery 5 years and 10 years after implementation of the recovery plan. In addition, we will conduct 5-year species status reviews required under the Section 4(c)(2) of the ESA.

The timing of the 5- and 10-year reviews is based on calendar years following the signing of the Mexican Wolf Recovery Plan, First Revision, in 2017. The PVA model was initiated using data through December 2015 (Miller 2017). The interim abundance and release and translocation targets to be used in the 5- and 10-year status reviews are derived from Vortex model years 7 and 12. This reflects the 2-year difference between the start of the Vortex model (end of 2015) and the signing of the recovery plan (end of 2017).

5-Year Status Review (based on data through 2022):
In the first 5-year review of the recovery plan, we will assess the status of each population contributing to recovery. The purpose of the assessment will be to identify each population's progress toward recovery criteria, as measured by:

- Interim abundance targets of approximately 145 wolves in the United States and 100 wolves in Mexico;
- Interim release and translocation targets of a sufficient number of wolves to result in approximately 9 released wolves surviving to breeding age in the United States and 25 released and translocated wolves surviving to breeding age in Mexico.

Based on this information, we will identify aspects of population performance needing improvement and will determine what actions are necessary to address identified needs. Our evaluation will include the feasibility of the needed actions, including timelines, cost, and other relevant considerations. To complete the review, we will update the Recovery Implementation Strategy as needed.

10-Year Status Review (based on data through 2027):
In the second 5-year review of the recovery plan, we will assess the status of each population contributing to recovery. The purpose of the assessment will be to identify each population's progress toward recovery criteria and determine whether the recovery strategy is proving effective/feasible. Progress toward recovery will be measured by:

- Interim abundance targets of approximately 210 wolves in the United States and 167 wolves in Mexico;
- Interim release and translocation targets of a sufficient number of wolves to result in approximately 16 released wolves surviving to breeding age in the United States and 37 released and translocated wolves surviving to breeding age in Mexico.

Based on this information, in addition to findings of the 5-year status review, we will make a determination that the recovery strategy is proving effective/feasible or needs to be revised. If we determine the recovery strategy is effective but some elements of recovery implementation need improvement, we will identify what needs to be improved, including actions to address identified needs and the feasibility of conducting such actions such as timelines and costs. If we determine the recovery strategy is not proving effective and the expected recovery level is not achieved, we will identify the reasons for such finding and, if necessary, revisit the recovery strategy and work with States and others to identify other areas with suitable habitat and adequate prey to achieve recovery; change techniques used to address gene diversity; or implement other substantive changes. Any such revised strategy should include revised time/cost estimates necessary to achieve recovery based on necessary actions. We will revise the Recovery Plan or Recovery Implementation Strategy as necessary.

VI. ACTIONS NEEDED

Recovery actions, which were developed for each objective, guide site-specific management activities to address threats and achieve the recovery criteria. They are provided in the Recovery Action Table below (Table 1). Implementation of the recovery actions will involve participation from the States, Federal agencies, counties, local communities, Tribes, non-federal landowners, non-governmental organizations, academia, and the public in the United States and Mexico. Recovery actions, organized by recovery objective, are accompanied by estimates of the cost and time required to achieve the plan's goal to recover the Mexican wolf.

The site-specificity of the recovery actions is provided primarily at the geographic scale of the population, e.g., the United States or Mexico. The Plan does not provide more specific locations for actions for which the locations cannot be determined until future conditions are known. For example, the Plan does not identify at which approved release site a future release may occur several years from now because it is unknown whether a specific site will be available (e.g., depending on wolf distribution). Similarly, we do not know when or where events that require law enforcement response will be necessary.

A separate Recovery Implementation Strategy provides additional detailed, site-specific near-term activities needed to implement the actions identified in the recovery plan. We intend to update the implementation strategy as frequently as needed by incorporating new information, including the findings of the 5 and 10-year status reviews. The implementation strategy will provide near-term (e.g., 1-5 years) activities that will be continually updated as recovery implementation progresses. Therefore, we anticipate being able to provide a greater degree of site-specificity in the implementation strategy than the recovery actions in the recovery plan. For example, release locations will be determined based on present-year circumstances. We will only revise the recovery actions in this recovery plan if there are needed changes based upon the findings of our 5 and 10-year status reviews, or subsequent evaluation of progress toward recovery.

As stated in the Disclaimer, recovery plans are advisory documents, not regulatory documents. A recovery plan does not commit any entity to implement the recommended strategies or actions contained within it for a particular species, but rather provides guidance for ameliorating threats and implementing proactive conservation measures, as well as providing context for implementation of other sections of the ESA, such as section 7(a)(2) consultations on Federal agency activities, development of Habitat Conservation Plans, or the creation of experimental populations under section 10(j).

Estimated Cost and Timing of Recovery

We expect the status of the Mexican wolf to improve such that we can achieve downlisting criteria around 2034-2038, approximately 16-20 years after implementation of the Mexican Wolf Recovery Plan, First Revision began at the end of 2017. We expect to achieve recovery in approximately 2043-2053, approximately 25-35 years after implementation of the Mexican Wolf Recovery Plan, First Revision began, for a total estimated cost of $202,959,000. This cost includes those borne by governmental agencies and nongovernmental organizations in the United States and Mexico.

While recovery may take an estimated 25-35 years, we anticipate successfully implementing the actions in the Recovery Action Table such that we can achieve recovery in 25 years; therefore, the total estimated cost to recovery is based on this 25-year timeframe. These timeframes are based on expectation of full funding, implementation as provided for in the recovery plan and implementation strategy, and full cooperation of binational partners.

Annual cost estimates to implement recovery actions for the first 5 years are as follows:

Year 1 = $7,749,000
Year 2 = $8,117,000
Year 3 = $8,397,000
Year 4 = $8,631,000
Year 5 = $8,691,000

The estimated cost to implement the first 5 years of recovery actions (i.e., intermediate steps toward the goal of recovery) is $41,585,000.

The calculation of the total estimated cost to recovery is included in the Recovery Action Table below, whereas, the cost of implementing the first 5 years of recovery is detailed in the Implementation Schedule Table of the Recovery Implementation Strategy.

Acronyms Used In Recovery Action Table

AZGFD	Arizona Game and Fish and Department
AZLLB	Arizona Livestock Loss Board
BLM	Bureau of Land Management
CBP	U.S. Customs and Border Protection
CONAFOR	Comisión Nacional Forestal
CONANP	Comisión Nacional de Áreas Naturales Protegidas
CNOG	Confederación Nacional de Organizaciones Ganaderas
DOT	Department of Transportation
DOW	Defenders of Wildlife
FGR	Fiscalía General de la Republica
FS	U.S. Forest Service
FSA	U.S. Department of Agriculture Farm Services Agency
FWS	U.S. Fish and Wildlife Service
GM	Grupo México-Unidad de manejo para la conservación de la vida silvestre (UMA) Buenavista del Cobre
GN	Gendarmería Nacional
INECOL	Instituto de Ecología, A.C.-Estación Biológica Piedra Herrada
MFS	Mexican Field Staff
MWF	Mexican Wolf Fund
MWLC	Mexican Wolf/Livestock Council
NMDGF	New Mexico Department of Game and Fish
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NGOs	Non-Governmental Organizations, unspecified

OVIS	Organización Vida Silvestre, A.C.-UMA La Mesa
PROFEPA	Procuraduría Federal de Protección al Ambiente
SADER	Secretaría de Agricultura y Desarrollo Rural (previously SAGARPA)
SAGARPA	Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación
SCT	Secretaría de Comunicaciones y Transportes
SEMARNAT	Secretaría de Medio Ambiente y Recursos Naturales
SSP	Species Survival Plan
TESF	Turner Endangered Species Fund
UI	University of Idaho
UNAM-FMVZ	Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autónoma de México
UNAM-IB	Instituto de Biología, Universidad Nacional Autónoma de México
UNM	University of New Mexico
USDA-WS	U.S. Department of Agriculture - Wildlife Services
WMAT	White Mountain Apache Tribe

Recovery Actions Added to the Implementation Schedule to Address Human-Caused Mortality

In response to the court-ordered remand of the 2017 recovery plan, we have added the following site-specific management actions to the Implementation Schedule (Table 1) to address the threat of human-caused mortality. We note that we may not identify the locations of recovery actions by geographic names (e.g., specific towns or counties) but rather by describing the places qualitatively in relation to the Mexican wolf population (e.g., "within occupied range" or "in areas where wolves disperse"). This is because we do not know where actions may be implemented until a future time or situation occurs.

1.1.1 Document U.S. wolf population parameters

We added this action because population parameters, in particular the annual mortality rate, provide critical information about the population's resiliency and the extent to which the threats of demographic stochasticity and human-caused mortality have been ameliorated (see p. 20). This information will help us adjust our management actions over time, as described in action 1.1.2, to ensure recovery progress. We describe our methods to measure population parameters in our annual reports, which are publically available on our website.

1.1.2 Determine whether annual mortality rate identified in 1.1.1 is consistent with meeting demographic and genetic criteria; adjust removal rate for upcoming year to support stable/growing population and adjust other pertinent management interventions (e.g., diversionary feeding) as necessary

We added this action in coordination with action 1.1.1 to reiterate our stated intention in the 2017 recovery plan to adaptively manage the population to adjust the number of removals we conduct based on documented mortality from other causes [than removals] during the previous year to ensure that the mean mortality rate over several years does not exceed the recommendations of the recovery plan (see p. 21). This action will compel us to make management adjustments to ensure recovery progress, although it may not directly address specific mortality causes. For example, if illegal killing is excessively high for one or several years, we may need to reduce our

management removals in order to keep the mean mortality rate below threshold levels that would result in population decline; this response does not solve the problem of excessive illegal killing, but it ensures that cumulative sources of mortality do not hinder the recovery effort. We have included other actions to directly address specific sources of mortality and consider the purpose of this action to be monitoring and triggering responsive adaptive management.

1.2.1 Document Mexico wolf population parameters
This action parallels action 1.1.1 to document Mexican wolf population parameters for the wild population in Mexico; the rationale is the same as stated above for 1.1.1.

1.2.2 Determine whether annual mortality rate identified in 1.2.1 is consistent with meeting demographic criteria; adjust removal rate or other pertinent management interventions (e.g., diversionary feeding) for upcoming year to support stable/growing population
This action parallels action 1.1.2 for the wild population in Mexico; the rationale is the same as stated above for 1.1.2.

1.6.1 Conduct education and outreach in local communities within occupied Mexican wolf range in the MWEPA and other areas where wolves disperse, including areas outside of the MWEPA where Mexican wolves have endangered status such as the I-40 corridor, in order to improve hunter, trapper, rancher, trade organization, and general public awareness and tolerance of wolves' presence, including materials with biological and legal information and conflict reduction techniques
This action is aimed at reducing various causes of illegal killing, for example:

- Education and outreach materials to emphasize physical differences between Mexican wolves and coyotes may reduce the likelihood of unintentional shooting of Mexican wolves due to mistaken identity as coyotes;
- Outreach materials to ensure the public, including hunters and trappers, are aware of wolf presence may reduce unintentional shooting or trapping;
- Education and outreach materials with biological information or that address wolf-human safety issues or legal forms of take may reduce intentional illegal shooting of Mexican wolves due to dislike or fear of wolves;
- Education and outreach materials may promote the awareness and use of wolf-livestock conflict reduction techniques by livestock operators, reducing the need for wolf removals by the Service and our partners, or through permits, in response to conflict situations such as depredations.

This action may include providing public accessibility to a comprehensive collection of outreach materials, strategies, programs, and goals specific to the Mexican wolf recovery effort, regular community meetings or other community events, and other approaches. We expect to develop and adapt the content of education and outreach materials over the course of the recovery effort to ensure materials are tailored to address current, localized sources of human-caused mortality in the MWEPA or areas where wolves disperse.

1.6.2 Increase law enforcement presence in areas identified as mortality hot spots to assist in public education, deter illegal killing, investigate wolf mortalities, and coordinate with law enforcement from other agencies

We added this action because we expect the presence of increased law enforcement to have a chilling effect on the intentional illegal killing of Mexican wolves. In addition, increased law enforcement will result in added capacity to investigate mortalities and coordinate actions across jurisdictions. We consider mortality hot spots to be localized areas where multiple mortalities demonstrate a pattern or higher likelihood for future Mexican wolf mortalities to take place. We cannot identify these site-specific areas ahead of time, but rather will continue to collect mortality data and determine whether or where hot spots exist, recognizing they may change over time and law enforcement presence will need to respond accordingly.

1.6.3 Install enhancements to facilitate Mexican wolf movement across existing and new roads and reduce vehicle collisions with Mexican wolves in occupied range, especially in areas likely to serve as corridors

This action is intended to reduce Mexican wolf mortality from vehicular collision. The specific location and type of enhancements will be determined by action 3.3.1, below, based on mortality data to identify specific areas where enhancements could be most beneficial (that is, reduce the likelihood of wolf mortality due to vehicular collision). The type of enhancements considered in a site-specific area would be determined based on a number of considerations such as the terrain, the reasons for collisions (high speed, prey corridor, etc.), and impacts to other wildlife or human uses of the area.

1.7.1 Conduct education and outreach to improve public tolerance and awareness of wolves' presence in areas occupied by wolves and other areas where wolves disperse, including materials with biological and legal information and conflict reduction techniques

This action parallels action 1.6.1; the rationale is generally the same as stated above for 1.6.1. However, we recognize that reasons for, and methods of, illegal killing may differ in Mexico (for example, intentional or unintentional poisoning of Mexican wolves may be more prevalent). Therefore, education and outreach programs will need to be developed based on mortality data gathered in Mexico as the program continues and tailored to appropriate site-specific areas and stakeholder groups.

1.7.2 Further efforts to increase law enforcement presence in the reintroduction/release areas and occupied range in Mexico, especially in areas identified as mortality hot spots, to deter illegal killing

This action parallels action 1.6.2; the rationale is the same as stated above for 1.6.2.

1.7.3 Investigate wolf mortalities

This action parallels action 1.6.2 and accompanies action 1.7.2 and it's rationale; it is separated from 1.7.2 because it has different responsible parties.

1.7.4 Install enhancements to facilitate Mexican wolf movement across existing and new roads, including Highway 2 between Cananea and Janos, and reduce the likelihood of vehicular collisions with Mexican wolves in areas likely to serve as corridors

This action parallels action 1.6.3; the rationale for this action is as stated for 1.6.3.

1.8.1 Implement livestock conflict avoidance measures in hotspots of depredation activity and areas with an increased risk of depredation activity, including on National Forests within the MWEPA, to reduce depredation-related wolf removals in the U.S.
This action is intended to address wolf-livestock conflicts occurring in a given year to reduce wolf removals as a necessary management response. Livestock conflict avoidance measures include techniques such as pasture rotations of livestock, the use of fladry (flagging) around sensitive areas such as calving areas, fence repair and maintenance, hazing, and range riders. We expect to continue working with livestock operators and our partners to develop, test, and implement conflict avoidance measures as needed throughout the MWEPA in hotspots of depredation activity. We consider hotspots to be areas with known and reoccurring wolf presence that has included multiple depredations in a short time span. We are available to assist our partners, at their request, in incorporating information about conflict avoidance meansures into their management documents.

1.8.2 Provide funding for wolf-livestock conflict avoidance measures to reduce depredation-related wolf removals in the MWEPA
This action complements action 1.8.1; the rationale for this action is as stated for 1.8.1.

1.9.1 Implement livestock conflict avoidance measures in hotspots of depredation activity in Mexico to reduce depredation-related wolf removals
This action parallels action 1.8.1; the rationale for this action is as stated for action 1.8.1.

3.3.1 Identify areas where enhancements (e.g., underpasses, overpasses, guiding fences) would improve the passage of Mexican wolves across road corridors in occupied range in the U.S. and Mexico to reduce the potential for wolf mortality from vehicular collision
This action complements (and precedes) actions 1.6.3 and 1.7.4. See our explanation of 1.6.3 above for the rationale for this action.

3.3.2 Monitor the effectiveness of enhancements post-construction
This action will help us determine the extent to which roadway enhancements are effective at reducing human-caused mortality of Mexican wolves from vehicular collision so that enhancements can be modified or additional enhancements can be implemented as needed.

In addition to adding the above actions, we also made the following revisions to the Implementation Schedule in response to the ruling:

- We removed "exceeding threshold mortality rate" as one of the threats addressed by *2.4 Monitor and manage Mexican wolf health* as it pertains to general wolf (health) monitoring and is not directly related to reducing human-caused mortality;
- We added "exceeding threshold mortality rate" as one of the threats addressed by *3.1 Maintain habitat for Mexican wolves in the U.S.* and *3.2. Maintain and protect habitat for Mexican wolves in Mexico*. Maintaining habitat for Mexican wolves will ensure that there are adequate prey populations to support wolves and less fringe habitat where wolves may interact with humans or development. This will reduce sources of human-caused mortality such as wolf removals due to conflict with livestock or nuisance behavior or vehicular collisions.

- We removed "exceeding threshold mortality rate" as a threat addressed by *3.4 Maintain or improve status of native prey population of Mexican wolves*. We do not believe that this site-specific action addresses excessive mortality directly. Rather, this action ensures that prey populations are adequate to sustain wolf populations as they reach and maintain demographic recovery goals.
- We clarified *5.1 Conduct education and outreach on Mexican wolf conservation in the U.S. to support the recovery effort as needed* by adding "also see 1.6.1 for education and outreach measures specific to reducing human-caused mortality". We made the same clarification to *5.2 Conduct education and outreach on Mexican wolf conservation in Mexico to support the recovery effort as needed.* We intend for actions 5.1 and 5.2 to serve as general education and outreach efforts that will support Mexican wolf recovery by providing information about any threat to the Mexican wolf or aspect of the recovery effort that would benefit from increased awareness and understanding; our clarification points to related actions that specifically address the threat of human-caused mortality.
- We clarified *6.4 Develop adequate regulations and management and monitoring plans to maintain viable Mexican wolf populations after delisting* by adding the wording "and ensure threats remain alleviated". This action will be taken during the recovery process to help ensure that Mexican wolf populations maintain recovered levels after delisting.

Table 1. Recovery Action Table: Estimated Cost, Time, and Priority for Recovery Actions for the Mexican Wolf

SITE-SPECIFIC ACTION[i]		RESPONSIBLE PARTY	ESTIMATED COST in FY18 (US dollars)	TREND of COST over TIME	ESTIMATED TIME (years)	TOTAL COST (US dollars)[ii]	PRIORITY[iii]	ADDRESSES THREAT[iv]
Objective 1: Increase the size of two Mexican wolf populations								
1.1	Survey and monitor Mexican wolves to determine population status in the U.S.	FWS, AZGFD, NMDGF	1,460,000	Stable	25	36,500,000	1	2, 3
1.1.1	Document U.S. wolf population parameters	FWS, AZGFD, NMDGF	Costs included in 1.1	Stable	25	Costs included in 1.1	1	2, 3
1.1.2	Determine whether annual mortality rate identified in 1.1.1. is consistent with meeting demographic and genetic criteria; adjust removal rate for upcoming year to support stable/growing population and adjust other pertinent management interventions (e.g., diversionary feeding) as necessary	FWS, AZGFD, NMDGF	Costs included in 1.1	Stable	25	Costs included in 1.1	1	2, 3
1.2	Survey and monitor Mexican wolves to determine population status in Mexico	CONANP, MFS	220,000	Increasing	25	12,120,000	1	2, 3
1.2.1	Document Mexico wolf population parameters	CONANP, MFS	Costs included in 1.2	Stable	25	Costs included in 1.2	1	2, 3

SITE-SPECIFIC ACTION[i]		RESPONSIBLE PARTY	ESTIMATED COST in FY18 (US dollars)	TREND of COST over TIME	ESTIMATED TIME (years)	TOTAL COST (US dollars)[ii]	PRIORITY[iii]	ADDRESSES THREAT[iv]
1.2.2	Determine whether annual mortality rate identified in 1.2.1 is consistent with meeting demographic criteria; adjust removal rate or other pertinent management interventions (e.g., diversionary feeding) for upcoming year to support stable/growing population	FWS	Costs included in 1.2	Stable	25	Costs included in 1.2	1	3
1.3	Monitor Mexican wolves on Fort Apache Indian Reservation	WMAT, FWS	225,000	Stable	25	5,625,000	1	2, 3
1.4	Monitor Mexican wolves on other Tribal lands	Tribes, FWS	20,000	Increasing	25	3,920,000	2	2, 3
1.5	Conduct Mexican wolf releases to increase population size in Mexico	See Action 2.2	See Action 2.2	See Action 2.2	See Action 2.2	See Action 2.2	2	1, 2
1.6	Reduce human-caused mortality of Mexican wolves in the U.S.	FWS, AZGFD, NMDGF, FS, WMAT	134,000	Increasing	25	6,298,000	2	3

SITE-SPECIFIC ACTION[i]		RESPONSIBLE PARTY	ESTIMATED COST in FY18 (US dollars)	TREND of COST over TIME	ESTIMATED TIME (years)	TOTAL COST (US dollars)[ii]	PRIORITY[iii]	ADDRESSES THREAT[iv]
1.6.1	Conduct education and outreach in local communities within occupied Mexican wolf range in the MWEPA and other areas where wolves disperse, including areas outside of the MWEPA where Mexican wolves have endangered status such as the I-40 corridor, in order to improve hunter, trapper, rancher, trade organization, and general public awareness and tolerance of wolves' presence, including materials with biological and legal information and conflict reduction techniques	FWS, AZGFD, NMDGF, FS, WMAT, NPS, BLM	Cost included in 5.1	Stable	25	Cost included in 5.1	2	3
1.6.2	Increase law enforcement presence in areas identified as mortality hot spots to assist in public education, deter illegal killing, investigate wolf mortalities, and coordinate with law enforcement from other agencies	FWS, AZGFD, NMDGF, WMAT, Other Tribes	Cost (of 134,000) included in 1.6	Increasing	25	Cost (of 3,350,000) included in 6.1)	2	3

SITE-SPECIFIC ACTION[i]		RESPONSIBLE PARTY	ESTIMATED COST in FY18 (US dollars)	TREND of COST over TIME	ESTIMATED TIME (years)	TOTAL COST (US dollars)[ii]	PRIORITY[iii]	ADDRESSES THREAT[iv]
1.6.3	Install enhancements to facilitate Mexican wolf movement across existing and new roads and reduce vehicle collisions with Mexican wolves in occupied range, especially in areas likely to serve as corridors (see 3.3.1).	FWS, AZGFD, NMDGF, CBP, Local, State, and Federal DOT	N/A	Increasing	15, or as needed	Fencing 100,000 per mile; Overpass 4,000,000 for 2-lane; Underpass 1,000,000 for 2-lane	2	3
1.7	Reduce human-caused mortality of Mexican wolves in Mexico	CONANP, MFS	32,000	Increasing	25	2,672,000	2	3
1.7.1	Conduct education and outreach to improve public tolerance and awareness of wolves' presence in areas occupied by wolves and other areas where wolves disperse, including materials with biological and legal information and conflict reduction techniques	CONANP, SADER	22,000	Increasing	25	2,422,000	2	3
1.7.2	Further efforts to increase law enforcement presence in the reintroduction/release areas and occupied range in Mexico, especially in areas identified as mortality hot spots, to deter illegal killing	FGR	10,000	Increasing	25	250,000	2	3
1.7.3	Investigate wolf mortalities	MFS, CONANP, PROFEPA	Costs included in 1.2	Stable	25	Costs included in 1.2	2	3

SITE-SPECIFIC ACTION[i]		RESPONSIBLE PARTY	ESTIMATED COST in FY18 (US dollars)	TREND of COST over TIME	ESTIMATED TIME (years)	TOTAL COST (US dollars)[ii]	PRIORITY[iii]	ADDRESSES THREAT[iv]
1.7.4	Install enhancements to facilitate Mexican wolf movement across existing and new roads, including Highway 2 between Cananea and Janos, and reduce the likelihood of vehicular collisions with Mexican wolves in areas likely to serve as cooridors (see 3.3.1)	CONANP	NA (cost included in actions 1.1, 1.2, 6.1)	Increasing	15, or as needed		2	3
1.8	Reduce Mexican wolf-livestock conflicts in the U.S. (MWEPA)	FWS, AZGFD, NMDGF, USFS, DOW, MWF, USDA-WS, MWLC, AZLLB	640,000	Increasing	25	24,100,000	2	3
1.8.1	Implement livestock conflict avoidance measures in hotspots of depredation activity and areas with an increased risk of depredation activity, including on National Forests within the MWEPA, to reduce depredation-related wolf removals in the U.S.	FWS, AZGFD, NMDGF, USFS, DOW, MWF, livestock operators	220,000	Increasing	25	9,550,000	2	3
1.8.2	Provide funding for wolf-livestock conflict avoidance measures to reduce depredation-related wolf removals in the MWEPA	FWS, MWF, DOW, AZGFD, NMDA, USDA-WS, NMDGF	240,000	Increasing	25	6,000,000+	2	3
1.9	Reduce Mexican wolf-livestock conflicts in Mexico	MFS, CONANP, CONAFOR	100,000	Increasing	25	4,850,000	2	3

SITE-SPECIFIC ACTION[i]		RESPONSIBLE PARTY	ESTIMATED COST in FY18 (US dollars)	TREND of COST over TIME	ESTIMATED TIME (years)	TOTAL COST (US dollars)[ii]	PRIORITY[iii]	ADDRESSES THREAT[iv]
1.9.1	Implement livestock conflict avoidance measures in hotspots of depredation activity in Mexico to reduce depredation-related wolf removals	CONANP, MFS, livestock operators	N/A	Increasing	25	N/A; Costs currently included in 1.2	2	3
Objective 2: Improve gene diversity and maintain the health of Mexican wolves								
2.1	Develop and implement an annual plan for Mexican wolf releases, cross-fostering, and translocations in the U.S.	FWS, AZGFD, NMDGF, FS, WMAT, TESF	400,000	Stable	16	6,400,000	1	1
2.2	Develop and implement an annual plan for Mexican wolf releases, cross-fostering, and translocations in Mexico	SSP, CONANP, MFS, SEMARNAT, OVIS, GM, INECOL, FWS	70,000	Stable	8	560,000	1	1, 2
2.3	Monitor and manage Mexican wolf genetic health in the wild	AZGFD, FWS, NMDGF, MFS, CONANP, UI, UNM	45,000	Stable	25	1,125,000	2	1
2.4	Monitor and manage Mexican wolf health in the wild	FWS, AZGFD, NMDGF, MFS, IFT, USDA-WS, UNAM-FMVZ	NA (costs included in 1.1 and 1.2)	NA (costs included in 1.1 and 1.2)	25	NA (costs included in 1.1 and 1.2)	2	2
Objective 3: Ensure adequate habitat availability to support viable Mexican wolf populations								
3.1	Maintain habitat for Mexican wolves in the U.S. in the MWEPA	FWS, AZGFD, NMDGF, FS, BLM, NPS, NRCS	NA (costs included in 1.1, 1.2, and 1.6)	NA (costs included in 1.1, 1.2, and 1.6)	25	NA (costs included in 1.1, 1.2, and 1.6)	2	2, 3

SITE-SPECIFIC ACTION[i]		RESPONSIBLE PARTY	ESTIMATED COST in FY18 (US dollars)	TREND of COST over TIME	ESTIMATED TIME (years)	TOTAL COST (US dollars)[ii]	PRIORITY[iii]	ADDRESSES THREAT[iv]
3.2	Maintain and protect habitat for Mexican wolves in Mexico in occupied areas or areas expected to be occupied in the near future	CONANP, MFS, UNAM IB	93,000	Decreasing	25	587,000	2	2, 3
3.3	Maintain and enhance connectivity within and between Mexican wolf populations in the MWEPA and Mexico	FWS, CONANP, SCT, AZGFD, NMDGF, CBP, Local, State, and Federal DOT	NA (cost included in actions 1.1, 1.2, 1.6.3, 1.7.4, 6.1)	NA (cost included in actions 1.1, 1.2, 1.6.3, 1.7.4, 6.1)	25	NA (costs included in actions 1.1, 1.2, 6.1)	2	1
3.3.1	Identify areas where enhancements (e.g., underpasses, overpasses, guiding fences) would improve the passage of Mexican wolves across road corridors in occupied range in the U.S. and Mexico to reduce the potential for wolf mortality from vehicular collision	FWS, CONANP, AZGFD, NMDGF; local, state, and Federal DOT; NGOs	NA (costs included in 1.6.3 and 1.7.4)	Stable	5-15	NA (costs included in 1.6.3 and 1.7.4)	2	3
3.3.2	Monitor the effectiveness of enhancements post-construction	Same as 3.3.1	NA (costs included in actions 1.1 and 1.2)	Stable	25	NA (costs included in 1.1 and 1.2)	2	2, 3
3.4	Maintain or improve the status of native prey populations of Mexican wolves in occupied areas or areas expected to be occupied in the near future	AZGFD, NMDGF, WMAT, IFT, CONANP, MFS	25,000	Stable	25	625,000	2	2
Objective 4: Maintain the Mexican Wolf SSP captive breeding program to improve the status of wild populations								

SITE-SPECIFIC ACTION[i]		RESPONSIBLE PARTY	ESTIMATED COST in FY18 (US dollars)	TREND of COST over TIME	ESTIMATED TIME (years)	TOTAL COST (US dollars)[ii]	PRIORITY[iii]	ADDRESSES THREAT[iv]
4.1	Manage the Mexican Wolf captive breeding population	Various SSP, FWS	2,674,000	Decreasing	25	54,682,000	2	1, 2
Objective 5: Promote Mexican wolf conservation through education and outreach programs								
5.1	Conduct education and outreach on Mexican wolf conservation in the U.S., locally (MWEPA), regionally (Southwst), and nationally (U.S.), to support the recovery effort as needed (also see 1.6.1 for education and outreach measures specific to reducing human-caused mortality)	FWS, AZGFD, NMDGF, WMAT, FS	450,000	Decreasing	25	9,000,000	3	1, 2, 3
5.2	Conduct education and outreach on Mexican wolf conservation in Mexico in areas of, or near, areas occupied by wolves or expected to be occupied in the near future (also see 1.7.1 for education and outreach measures specific to reducing human-caused mortality)	MFS, CONANP	NA (costs included in 1.7)	NA (costs included in 1.7)	25	NA (costs included in 1.7)	3	1, 2, 3
Objective 6: Ensure recovery success								
6.1	Manage the Mexican Wolf Recovery Program in the U.S.	FWS	500,000	Decreasing	25	8,500,000	3	1, 2, 3
6.2	Manage the Mexican Wolf Recovery Program in Mexico	CONANP, MFS, SEMARNAT	35,000	Stable	25	875,000	3	1, 2, 3

SITE-SPECIFIC ACTION[i]		RESPONSIBLE PARTY	ESTIMATED COST in FY18 (US dollars)	TREND of COST over TIME	ESTIMATED TIME (years)	TOTAL COST (US dollars)[ii]	PRIORITY[iii]	ADDRESSES THREAT[iv]
6.3	Coordinate binational Mexican wolf recovery efforts in the U.S. and Mexico	FWS, CONANP	NA (costs included in 6.1 and 6.2)	NA (costs included in 6.1 and 6.2)	25	NA (costs included in 6.1 and 6.2)	3	1, 2, 3
6.4	Develop adequate regulations and management and monitoring plans to maintain viable Mexican wolf populations and ensure threats remain alleviated after delisting	CONANP, FWS, AZGFD, NMDGF, WMAT	NA (costs included in 6.1 and 6.2)	NA (costs included in 6.1 and 6.2)	5	NA (costs included in 6.1 and 6.2)	3	1, 2, 3
TOTAL COST			7,749,000			202,959,000		

[i] The Recovery Implementation Strategy provides additional detailed, site-specific near-term activities needed to implement the actions identified in this Recovery Action Table.

[ii] Because the estimated costs of some actions may increase or decrease over the duration of the action, the total cost of the action cannot be calculated by multiplying the cost of the action in Fiscal Year 2018 by the estimated time of the action. Whether the trend of the cost is increasing, decreasing, or stable over the total duration of the action is indicated in the "Trend of Cost over Time" column; however, the calculation of the total cost estimate of each action is included in greater detail in the Implementation Schedule Table.

[iii] Recovery actions are assigned numerical priorities to highlight the relative contribution they may make toward species recovery (48 FR 43098). **Priority 1** – An action that must be taken to prevent extinction or to prevent the species from declining irreversibly. **Priority 2** – An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction. **Priority 3** – All other actions necessary to provide for full recovery of the species.

[iv] Threats numbering system: 1) Loss of gene diversity; 2) Extinction risk/demographic stochasticity; 3) Exceeding threshold mortality rate

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VIII. APPENDIX: PUBLIC COMMENTS AND PEER REVIEW

Peer Review and Responses

We received peer reviews on the draft revised recovery plan from three independent experts who previously reviewed the 2017 recovery plan. These reviewers provided feedback on the recovery actions, as well as other components of the recovery plan. Due to our focus during this revision on the addition of recovery actions to address the threat of human-caused mortality, we only provide synthesis and responses to the issues related to the remand. Overall, two peer reviewers supported the new recovery actions and stated that the new recovery actions would address the threat of human-caused mortality; one peer reviewer stated that it was not his area of expertise and therefore he could not determine whether the actions would be adequate to address the threat. We have not included general statements of support for specific actions from peer reviewers because we did not need to consider any revisions based on those comments.

Comment: I am highly confident that introgression of northern (gray wolf) genes to Arizona and New Mexico wolves will bring about greater population vigor, such that the Mexican wolf population would have lower susceptibility to illegal killing, and better demographic ability to exhibit population growth despite illegal killing. The Service should include a high priority action to experimentally cross some northern wolves with captive *baileyi* wolves.
Response: Previous recovery teams have discussed potential strategies to interbreed Mexican wolves with gray wolves to improve the gene diversity of the Mexican wolf. The Service has not, and is not at this time, adopting any interbreeding recommendations or strategies because we consider the gene diversity of Mexican wolves to be sufficient for recovery. We are not aware of any literature or other information suggesting that interbreeding strategies would make Mexican wolves less susceptible to illegal killing. However, we will continue to gather information and consider various strategies to alleviate genetic threats to the Mexican wolf as we proceed with the recovery effort. We intend to convene a genetics subgroup that will assist the Service in this effort.

Comment: I support collecting and analyzing mortality rates and other demographic parameters and using these data and analyses to help inform actions to reduce illegal killing and modify management removals. I am frankly surprised that the Service has not been systematically collecting such data and conducing such analyses over the decades since reintroduction.
Response: The Service, our partners, and our counterparts in Mexico regularly collect data on the demographic parameters of wolves in the U.S. and Mexico. We have included this as an action because it corresponds with recovery action 1.1.2 to determine whether the mortality rate is consistent with meeting demographic criteria. We note that we may adjust our monitoring and data collection methodology as the populations continue to grow in both countries.

Comment: In 1.6.2, I was quite honestly stunned to read that the Service has not already identified mortality hotspots, especially hotspots of illegal killing, roadkill, and depredation. With large numbers of radio-tagged wolves, I have long assumed that such hotspots were easy to discern and were already known. I support collecting such data and using it to guide recovery actions.
Response: Service law enforcement personnel, and law enforcement personnel from partner agencies, regularly assess Mexican wolf mortality data to determine whether there are patterns to

the occurrence of illegal mortalities. We have added this recovery action to the recovery plan to foster greater public awareness of our ongoing efforts as well as to facilitate increased coordination and emphasis on this action by the Service and our partners to reduce or eliminate hot spots of mortality.

Comment: Increasing law enforcement efforts is a more complicated issue in my experience, as some individuals may retaliate. Nonetheless, the net benefit will likely be a reduction in malicious killings and may help identify new ways to reduce overall conflicts simply through increased interaction with various groups.
Response: In addition to increasing law enforcement, the Service and our partners will increase our interaction and collaboration with stakeholder groups to build education and outreach programs intended to increase tolerance for Mexican wolves and reduce illegal killing. We will adapt our approach over time based on the efficacy of our efforts, while recognizing that some individuals may never support the recovery effort.

Comment: Although the intention of section 3.3.1 is clear and logical, more detail would be helpful. What specifically would be monitored in terms of the effectiveness of such mitigation measures? Would these include documenting improvements to connectivity, or just focus on reducing vehicle-related mortalities? Either way, defining targets in terms of which variables are important, how they will be measured, and what constitutes success would improve this section.
Response: We agree that additional specificity will be necessary as we move forward with recovery action 3.3.1 and 3.3.2, as well as 1.6.3 and 1.7.4, all of which are components of determining the degree to which various roadway enhancements could contribute to reducing human-caused mortality of Mexican wolves. We are currently (August 2022) mapping the locations of Mexican wolf mortalities from vehicular collision to determine whether there are areas of particular risk to wolves in the MWEPA. We will work with a variety of partners and parties to explore the potential efficacy and cost of different roadway enhancements. A monitoring scheme to document the effectiveness of enhancements will be developed and implemented as part of the process to select and install enhancements. We will develop and include these types of specific activities in our recovery implementation strategy, which is a separate planning document we use to organize and schedule tasks that contribute to our broader recovery actions.

Comment: The scheduled reviews of the various aspects of the program are also vital to the plan. These should serve to increase support for recovery as the public will be able to see the successes and failures for themselves, as well as provide insights that the recovery team can apply in the future.
Response: We look forward to conducting the 5- and 10-year recovery plan evaluations to assess the efficacy of our current recovery strategy and our progress toward recovery criteria in the U.S. and Mexico. We agree that the evaluations also provide an opportunity to communicate our progress with the public and engage stakeholders in the recovery effort.

Public Comments and Responses
The U.S. Fish and Wildlife Service released the draft Mexican Wolf Recovery Plan, Second Revision for public comment and peer review on April 14, 2022 (87 FR 2226). We specifically requested information related to the new recovery actions we added to this version of the plan to

address the threat of human-caused mortality in response to the court-ordered remand of the Mexican Wolf Recovery Plan, First Revision (USFWS 2017); we explained that we do not intend to revise any portion of the plan other than the recovery actions during this remand process (see Request for Public Comments, 87 FR 22226, p. 22228). The comment period lasted for 30 days and closed on May 16, 2022. At the close of the review period on the draft Recovery Plan there were over 48,000 comments from the public submitted on www.regulations.gov to docket number FWS-R2-ES-2022-0018. These included comments from interested citizens as well as Federal, State, and local agencies and governments, Tribes, non-governmental organizations, and interest groups.

Below, we provide our response to the substantive comments received during the comment period. Substantive comments were those that provided information related to the new recovery actions we added to this version of the plan to address the threat of human-caused mortality. Due to the similarity of many comments, we synthesized multiple comments into a single comment when possible. We have organized the comments and our responses based on subtopics relevant to the topic of human-caused mortality. The vast majority of comments we received were either duplicative or non-substantive in nature. We evaluated as non-substantive those comments that only expressed either support for, or opposition to, the recovery of Mexican wolves with no supporting information. Some comments were substantive to some aspect of Mexican wolf recovery but did not provide information related to the new recovery actions that we are focused on in this version of the recovery plan. We will continue to discuss those concerns and recommendations as we implement Mexican wolf recovery.

Comments from State Agencies

Comments received from State agencies included New Mexico Department of Agriculture, Arizona Game and Fish Department, and the Office of the Governor of Utah. Comments that expressed support for the draft revised recovery plan, including the new actions, and encouraged prioritizing, funding, and implementing the measures are not reiterated here but have been noted.

Comment: Although any factor that can be controlled to reduce mortality is helpful, human-caused mortality is currently below a threshold that would impact meeting demographic recovery criteria in the revised recovery plan.

Response: The Service agrees that the MWEPA population has demonstrated robust population growth in recent years despite human-caused mortality and has the potential to achieve the population objective even if human-caused mortality were not reduced from current levels (2015-2022). However, the goal of recovery is to ensure that populations are robust, and threats have been alleviated such that the protections of the Act can be lifted. Therefore, it is important to ensure that sources of mortality are sufficiently reduced and remain low enough to sustain recovered status over the long-term, including when the population is not experiencing robust growth. We look forward to continuing to work with our partners in the U.S. and Mexico to reduce human-caused mortality to Mexican wolves so that delisting can be pursued when demographically and genetically robust population have been established and maintained.

Comment: It would be helpful for the Service to assess the locations of human-caused mortality to allow both enforcement and outreach to target locations where high numbers of mortalities have occurred.

Response: The Service's Office of Law Enforcement regularly assesses the locations of illegal killings of Mexican wolves to prioritize their near-term educational, enforcement, and investigatory actions. In addition to this, we will undertake a broader assessment of human-caused mortality as part of the 5-year evaluation of the recovery plan, scheduled for 2022-2023.

Comment: Signage should be bolstered throughout the MWEPA to assist in the identification of coyotes versus Mexican wolves.
Response: The Service will work with our External Affairs staff and our partner agencies to implement this recommendation.

Comment: It would be helpful for the Service to review and provide the number and locations where roadway collisions have occurred to optimize efforts for reducing mortalities. Signage should be the first option considered, as this is a cost-effective first step to be evaluated. Items such as overpasses, while on the surface appealing, are not economically justifiable based on a cost-benefit analysis for the low volume roadways within the MWEPA. As an example, a single overpass is expected to cost over $3.0 million and will take years of planning to implement where signage can be placed in mere weeks. The money spent on this action should be commensurate with the degree of threat alleviation that could be accomplished.
Response: During August 2022, we will map the locations of Mexican wolf mortalities due to vehicular collision to determine whether there are specific roads or areas in which a higher prevalence of mortalities suggest that roadway modifications could be effective to reduce the likelihood of future mortalities. Based on this information, we will work with the States, transportation departments, federal agencies, local governments, and NGOs to assess the most effective and cost-efficient remedies. We agree that some roadway modifications are prohibitively expensive when viewed against their potential to reduce the threat of vehicular mortality of Mexican wolves and that lower cost modifications, if effective, would be preferable.

Public Comments - Sources of Mortality and Management Responses
Comment: The Service should develop and implement a system for the use of non-lethal management tools in which the agency ensures the proper design and employment of non-lethal methods through annual inspection, uses non-lethal tools in a step-wise fashion (i.e., the failure of one non-lethal method leads to the implementation of another method until all available non-lethal methods proven by randomized, controlled trial to deter wolves from property have been attempted), and provides photos and other forms of outreach for public information. This process should be developed using the best available science with preference for peer-reviewed articles in journals.
Response: We agree that proper implementation is critical to the success of non-lethal tools; we continue to work with, and learn from, our partners and livestock operators toward this end. We will consider the suggestion to formalize aspects of our non-lethal management approach because we recognize the important role that these tools play in the success of the recovery effort, particularly as the population continues to grow.

Comment: The County is concerned about the Service's suggestion that illegal killings may result in a need to reduce management removals to keep the mean mortality rate below threshold levels that would result in population decline. Among other things, management removals are

necessitated by excessive depredations by problem wolves, habituated wolves, and adverse wolf/human interactions. Utilizing excessive illegal killing as a basis upon which to reduce management removals will result in increased animosity between the public and the Service, and result in adverse wolf/human interactions by virtue of the Service's failure to remove problem and habituated wolves.
Response: We expect to employ a number of tools to address conflict situations, including non-lethal management tools and when necessary, management removals. Increased law enforcement efforts from our agency, as well as our partners, will also be implemented to reduce incidents of illegal killing. We recognize the tension created by our intention to adjust our removal rate as part of the overall mean mortality rate of adult Mexican wolves, but if illegal killing persists, this type of annual adjustment is a necessary component of recovering the Mexican wolf.

Comment: Regarding recovery action 1.8.1, which calls for implementing conflict avoidance measures in depredation hotspots, we believe conflict avoidance measures, especially proactive livestock management, must occur outside depredation hotspots as well. As written, site-specific action 1.8.1 is reactive not proactive. Once the agency identifies a hotspot, wolf-livestock conflicts have already occurred. FWS should place more emphasis on proactive conflict avoidance measures by including proactive language. For example: "Implement livestock conflict avoidance measures in hotspots of depredation activity and areas with an increased risk of depredation activity to reduce depredation-related wolf removals." By adding proactive language, FWS can prevent conflicts and build trust with livestock producers, which can increase tolerance and reduce the necessity for wolf removals.
Response: We have revised the wording of the recovery action 1.8.1 in response to this comment; we agree that proactive conflict avoidance measures should be emphasized as a strategy to reduce human-caused mortalities.

Comment: We are concerned that the Service may use supplemental feeding as its primary tool to support population growth instead of reducing removals. The Service should commit to adjusting removal rates first because relying on supplemental feeding as a primary tool may contribute to the genetic threats facing the Mexican gray wolf. We recommend that site-specific action 1.1.2 be amended as follows: "Determine whether annual mortality rate identified in 1.1.1 is consistent with meeting demographic and genetic criteria; adjust removal rate for upcoming year to support stable/growing population; adjust other pertinent management interventions (e.g., supplemental and diversionary feeding) only as necessary."
Response: We have revised the wording of recovery action 1.1.2 in response to this comment.

Comment: Instead of decreasing management removals in response to illegal killings (recovery action 1.1.2), the Service could instead increase releases of well-bonded families with pups. If, for example, the Service committed to releasing one wolf pack from captivity for every illegal mortality or suspicious death, it would more effectively counteract the loss of the wild wolves and provide a disincentive for the wolf-killing community. Where legal penalties require years of investigation and prosecution, the near-term penalty of not having accomplished anything (i.e., not succeeding in damaging the recovery effort overall) may serve to dissuade those who would otherwise seek to hamper the program's success.
Response: The release of Mexican wolf family groups remains an allowable management action under our MWEPA regulations. At this time, we are not committing to the release of one wolf

pack in response to each illegal killing because the release of adult Mexican wolves is not our preferred release strategy (see III. Recovery Strategy: Genetic Management).

Comment: The USFS should be listed as a responsible party for action 1.8.1 because they are in a better position, as the land management agency, to implement the conflict avoidance measures, talk with permittees, establish standards and guidelines, and provide best practices for permittees. We suggest that the final recovery plan include stronger language stating that FWS will help other agencies incorporate correct language into their management policy documents.
Response: We have added USFS to the list of responsible parties for action 1.8.1 and agree that as the primary land manager in the MWEPA of suitable habitat for the Mexican wolf they have an important role in reducing livestock conflicts. We have also added a sentence to the description of action 1.8.1 stating our availability to assist our partners, at their request, incorporating information about livestock conflict avoidance measures into their management documents.

Comment: The Arizona Game and Fish Department and Department of Transportation have over two decades experience researching and managing wildlife-vehicle conflicts on major travel corridors. Those efforts have proven extremely successful when guided by site-specific data on wildlife behavior and movements. A similar approach would be appropriate for the Mexican wolf, especially if considering expensive crossing structures or other infrastructure modifications.
Response: We agree that these parties have extensive experience and expertise related to mitigating wildlife-vehicle conflicts. See the comment and response above in "Comments from State Agencies", which discusses the efficacy and cost of implementing roadway modifications.

Comment: To address mortalities by vehicle collisions, the Service should work with Arizona, New Mexico, and the USFS to apply for funds through the recently created Wildlife Crossings Pilot Program created by the Infrastructure Investment and Jobs Act. The program provides federal funding for wildlife crossing enhancements to reduce wildlife-vehicle collisions. FWS should prepare and make publicly available its plan for funding wildlife crossing enhancements. The Service should also explore information available from the Western Transportation Institute, which has been a leader in developing and implementing such structures: https://westerntransportationinstitute.org/tag/wildlife-crossing-structures/
Response: As of August 2022, we are in the process of identifying areas where there may be an increased likelihood of Mexican wolf-vehicular collisions, which is a component of recovery action *3.3.1 Identify areas where enhancements (e.g., underpasses, overpasses, guiding fences) would improve the passage of Mexican wolves across road corridors in occupied range in the U.S. and Mexico to reduce the potential for wolf mortality from vehicular collision.* Pending the results of our assessment, we will work with all interested parties, including agencies or non-governmental organizations, to determine where roadway modifications may be beneficial. This will include exploring the various types of roadway modifications and available funding mechanisms, as well as looking to leaders such as the institute noted by the commenter.

Comment: The recovery plan should explain the best available science about human tolerance for wolves. The plan should state "Loosening of protections for listed wolves encourages illegal behavior and intolerance."

Response: We have followed the science associated with topic and note that there is scientific disagreement about this hypothesis that is primarily proposed by one group of authors. Nevertheless, the prediction would be that the tightened regulations from 2022 10(j) would decrease illegal behavior and intolerance. We will continue to look for scientific consensus with the accumulation of data and further publications. We did not incorporate the debated hypothesis because we continue to predict that management flexibility to reduce wolf/livestock conflict increases social tolerance from the ranching community.

Comment: There is more that USFS can and should do to reduce human-caused mortality and removals on National Forests in Arizona and New Mexico. We recommend that the final recovery plan include a new site-specific action stating the USFS and FWS will work together during the forest planning process to include wolf-specific standards and guidelines in their revised Forest Management Plans. Some National Forests already include wolf-specific standards and guidelines. For example, the Chequamegon-Nicolet National Forests in Wisconsin have standards and guidelines that protect and buffer Eastern Timber Wolf dens and rendezvous sites. Including such standards and guidelines in the Arizona and New Mexico National Forest plans could significantly reduce conflict between Mexican gray wolves, humans, and livestock. The Service should also work with the USFS to incorporate mandatory wolf friendly livestock management practices in Allotment Management Plans and Annual Operating Instructions for livestock producers.
Response: In response to this comment, we have added USFS as a responsible party to recovery action 1.8.1 and have included the National Forests in the MWEPA as a subset of the locations where this action should take place. We have added a sentence to the description of the recovery action to state that we will assist partners to incorporate information about conflict avoidance measures into their management documents at their request.

Comment: The only way to wean Mexican gray wolves from perpetual supplemental and diversionary feeding is for FWS to proactively engage the USFS and other cooperating agencies to better manage livestock grazing to reduce the potential for wolf-livestock conflict. The Service must provide a plan for preventing wolf-livestock conflict once feeding stops otherwise the Service has merely delayed the threat, not neutralized it.
Response: We will discuss our current use of supplemental feeding in the 5-year evaluation of the recovery plan in 2022-2023 and our expectations for use of this tool in the near future (5 years).

Comment: A significant barrier to proper implementation of non-lethal conflict methods is that many non-lethal methods are not standardized and come in many different forms. Range riding, for example, has only been experimentally evaluated on one occasion. While it was shown to work, the range riding method studied was livestock focused, is not widely used, and likely differs from the method currently employed by the Service. Therefore, the Service should prioritize defining and implementing methods that have been studied and are well researched or helping to facilitate research on methods that are yet understudied.
Response: There is ongoing research into evaluating non-lethal tools through the Natural Resources Conservation Service – Conservation on Working Lands grant. The research is being conducted across the western U.S. The Service is collaborating with this research in the Southwest.

Comment: The Service should develop a plan to offer subsidies for non-lethal methods but only when installed correctly and maintained as documented by a third-party verifier who has proven credentials in evaluating the installation, effectiveness, and maintenance of non-lethal methods. The National Wildlife Research Center of USDA Wildlife Services are specialists in non-lethal methods.
Response: The features recommended by the commenter are not currently included in the existing program that awards funding for non-lethal management activities. We will explore this idea further as we continue to expand and strengthen our use of non-lethal tools. Currently, the Wolf Livestock Demonstration Grants are authorized by the Omnibus Public Lands Management Act of 2009 (P.L. 111-11) and awarded by the Service through a nation-wide competitive process to qualifying States and Tribes. Approximately $1,000,000 is provided annually to (1) assist livestock producers in undertaking proactive, non-lethal activities to reduce the risk of livestock loss due to predation by wolves and (2) compensation to livestock producers for livestock losses due to wolf predation. P.L. 111-11 states that funding made available should be allocated equally between the two purposes (compensation and non-lethal prevention), and that the Federal share of the cost does not exceed 50 percent (requires a 50% non-Federal match). In fiscal year 2021, the states of Arizona (AZGFD) and New Mexico (NMDA) were awarded a combined total of $480,000; $210,000 for non-lethal prevention and $270,000 for compensation. The required $480,000 in non-Federal match was provided primarily in the form of non-lethal prevention.

Comment: We recommend the Service initiate a consultation with the Department of Justice (DOJ), pursuant to ESA Section 7(a)(2) as to the impacts of the McKittrick Policy on the continued survival and recovery of Mexican wolves and urge the DOJ to suspend further application of the McKittrick Policy in connection with the illegal killing of Mexican wolves. The McKittrick Policy is a major continuing hindrance to species recovery and must be suspended in order for the Service to address the illegal killing of Mexican wolves.
Response: The Service actively investigates every Mexican wolf mortality and seek criminal prosecution in collaboration with the Department of Justice. When criminal prosecution is deemed unsuitable due to Department of Justice policies, the Service will seek civil action in the form of civil penalties to the fullest extent allowed by Federal law. In every instance, the Service continues to consult and collaborate with the Department of Justin and the Department of Interior's Office of the Solicitor on enforcing the ESA.

Comment: The FWS should firmly state a position that reinforces the strongest ESA protections for Mexican wolves asserting the only condition under which a Mexican wolf can be killed is under imminent threat to human safety. Substantial research documenting human-caused mortality in both Mexican wolves and other North American wolf subspecies has found that liberalized killing of wolves results in a direct increase in the hazard and incidence of illegal killings. (Louchouarn et al. 2021, Santiago-Ávila et al. 2022, Santiago-Ávila et al. 2020, Treves et al. 2021).
Response: Our 10(j) regulations for the MWEPA include several forms of allowable take of Mexican wolves under very limited and specific circumstances; we recently revised the allowable forms of take for the MWEPA to further restrict the take of Mexican wolves on Federal and non-Federal land and in response to an unacceptable impact to a wild ungulate herd while we make progress toward recovery (87 FR 39348, July 1, 2022).

Comment: We offer Project Coyote's Ranching with Wildlife program as a model. Our program works collaboratively with diverse stakeholders united by the goal of coexistence among humans, livestock, and wildlife. We work directly with local wildlife organizations, ranchers, scientists, and county officials across the country to directly and simultaneously protect both domesticated and wild animals. Our work includes developing and implementing long-term carnivore coexistence programs, field testing predator deterrents, and promoting the understanding and appreciation of the key ecological role of carnivores on the landscape.
Response: We look forward to expanding our collaborative efforts working with non-governmental organizations; State, Federal, and Tribal agencies; local governments and communities; and others to increase coexistence between wolves and people and their livestock.

Comment: The Service has been slow to publish mortality data, including causes of death that are under investigation as potential illegal killings. The agency has a responsibility to not only measure mortality but investigate and publish the results in a timely manner as part of a transparent process of tracking mortality and working to reduce human-caused mortality.
Response: The Service publishes mortality information in several formats, at several times during the year. We publish an annual report that contains demographic information, including the minimum population size and known mortalities. We also publish quarterly reports which contain this information. We may not report the cause of death if the mortality is under active investigation by Law Enforcement, which is important to the success of the investigation.

Comment: There is lack of clarification in section 1.1.2 in regard to the excerpt "…if illegal killing is excessively high for one or several years…". Some specific unacceptable level of illegal killing needs to be defined here. Also, while you state that this does not solve the problem of excessive illegal killing, shouldn't there be a stated/defined threshold level of killing which, if being approached or, for sure, surpassed, will trigger other actions to be taken/implemented to address and further prevent such a level of killing?
Response: The level of illegal killing that occurs is a subset of the total mortality that occurs in a wolf population. We explain in the recovery plan that mean adult Mexican wolf mortality rates should stay below 25% in order for the population to grow or remain demographically stable. Therefore, the level of illegal killing that is considered a concern may shift from year to year based on the population size and its trajectory, the amount of illegal killing, and the overall mortality rate. This determination will be made on an annual basis in each population (the U.S. and Mexico) and management adjusted accordingly to support the stability and growth of the population(s).

Comment: Wolves that disperse beyond the boundaries of the MWEPA should not be captured and moved back into the MWEPA because trapping and tranquilizing a wolf for such translocation poses a risk of injury or death for the wolf. The agency has inadvertently killed wolves from the stress of capture.
Response: We agree that capture operations can pose a risk of injury or death to a wolf. However, our husbandry protocols for these operations result in a level of risk that is acceptably low compared to the challenges that could arise from a wolf occupying habitat that is outside of the MWEPA where our management flexibilities are not available.

Comment: The proposal also discusses implementing and funding livestock conflict avoidance measures in hotspots of depredation activity to reduce depredation-related wolf removals (Recovery Action 1.8.1). If the USFWS moves forward with this proposal, we urge the agency to work directly with livestock operators in identified depredation hotspots to determine which avoidance measures would be most effective.
Response: We have added livestock operators as a responsible party to action 1.8.1 in response to this comment because we agree that coordination and collaboration directly with livestock operators will contribute significantly to a reduction in depredation-related wolf removals.

Comment: The FWS should identify how many depredation-related wolf removals it has actually conducted, what it did with the wolf and whether the wolf was released again. Note that the listed measures have costs that are imposed on ranchers who are not compensated for them. The FWS does not say that it will pay for these measures.
Response: The Service tracks and publishes data on all Mexican wolf removals conducted, including whether the wolf is subsequently re-released to the wild or is permanently moved to captivity. The recovery plan estimates the costs involved for the recovery actions but does not commit any party to the expenditures listed. Compensation for some proactive management is available in Arizona and New Mexico, as well as compensation for confirmed depredations. Information about compensation programs is available on-line on our website or by contacting our office or AZGFD and NMDGF.

Comment: Can grazing rights be removed as a management tool to reduce the amount of illegal killing in high mortality areas?
Response: The revocation of grazing rights is under the purview of the USFS, not the Service.

Comment: Are ranchers who kill wolves due to depredation required to implement livestock monitoring methods? It would be very useful to be able to see the data on illegal killing of wolves in a timely fashion, how the killing occurred, and what reasoning was given.
Response: Ranchers are not required to monitor livestock before or after a conflict with Mexican wolves. Mortality data is provided in our quarterly reports (four times per year) and our annual reports.

Comment: The Service should use small volunteer teams to help track collared wolves. www.ventanaws.org/volunteer.html is one of many volunteer programs for condor monitoring. This type of program can be implemented even in the most remote areas.
Response: The Service and DOW currently collaborate on a volunteer program in which volunteers serve six-month internships to conduct Mexican wolf field work. We will look into the program suggested by the commenter to determine whether there may be additional opportunities to utilize volunteers on the program.

Comment: The Service assumes the Mexican wolf population will grow or remain stable if the mean adult mortality rate is less than 25%. Scientists indicate an estimated annual rate of human-caused losses must average less than 20%. The Service must use more conservative modeling to ensure high human-caused mortality doesn't jeopardize recovery efforts. Up-to-date mortality data must be readily available for the public.

Response: We worked with scientists to gather and analyze the best available data and information to inform our estimate that a mean adult mortality rate less than 25% will result in a stable or growing population. The mortality rate at which a specific wolf population will increase, or decrease, is dependent on a variety of parameters specific to that population; that is, there is no "one size fits all" estimate of mortality rate that should be applied as a management standard to all wolf populations. Conversely, we have ensured that the mortality rate we have selected is based on the characteristics of the Mexican wolf and the MWEPA.

Comment: The Service should set firm requirements for the use of non-lethal tools to resolve conflicts with livestock. There are many ways to deal with livestock conflicts which do not result in wolf killing, such as retiring grazing areas with a history of repeated wolf-livestock conflicts, removing livestock carcasses, rending the carcasses inedible, increasing livestock monitoring through range riders who can move livestock out of vulnerable areas, and allowing wolves to use the habitat they need to recover.
Response: A recovery plan is a guidance, rather than regulatory, document, which means that it cannot require action from any party. If we were to require the use of non-lethal tools to resolve conflicts, we would do so in the 10(j) regulations for the MWEPA. We currently emphasize the use of non-lethal tools and employ as many options as available to try to resolve the issue before pursuing lethal removal.

Comment: The Service needs to consider the border wall and its impact on connectivity. Wolves need to be able to travel between connected habitats using safe corridors where they will be protected from illegal killing and vehicle mortalities.
Response: We consider the border wall and its impact on connectivity in the recovery plan, as well as the Mexican Wolf Biological Report (USFWS 2017a). Mexican wolves have not experienced levels of mortality that are significant at the population level associated with movement across the border. We work closely with our counterparts in Mexico to monitor and manage wolves that disperse over the border in either direction.

Comment: Proactively planning to expand the area wolves can disperse and can be released would not only better serve the biological needs of the species but could also be part of a strategy to reduce human-caused mortality compared to continuing to cross-foster pups into areas with high historic conflict and high human-caused mortality.
Response: Wolves are currently able to disperse throughout most of the MWEPA, with the exception of some parts of Arizona, as provided for by the phasing approach established by our MWEPA regulations. Sufficient suitable habitat remains available in the MWEPA for continued geographic expansion of the wolf population, regardless of the age of wolves we release (i.e., adult wolves versus cross-foster pups.

Comment: By providing ranchers and hunters with location data and telemetry receivers that are pre-programmed to the radio frequencies of endangered wolves, USFWS is actively contributing to illegal poaching of the Mexican Wolf. Releasing information about where wolves are so that hunters and ranchers know when wolves are in the area does not motivate hunters and ranchers to avoid them. It provides them with the opportunity to easily bait wolves onto their ranges where they can easily be poached.

Response: We consider the provision of location data and telemetry receivers to livestock operators necessary to foster the implementation on non-lethal conflict avoidance management measures by those operators. We do not supply this information to hunters. All illegal mortalities are investigated by Law Enforcement.

Comment: In addition to developing and implementing livestock conflict avoidance measures in hotspots of depredation activity to reduce depredation-related wolf removals, why not stop all depredation-related wolf removals? That would provide further economic incentive to cattle owners to implement avoidance measures seriously.
Response: The Service and our partners consider wolf removal to be a management tool that is less preferable than non-lethal options but may still be needed in some circumstances. Regardless, the recovery plan is a guidance document and therefore cannot establish or modify the allowable forms of take in the MWEPA or Mexico.

Comment: In a survey reported in Smithsonian Magazine, more than half the ranchers responding wanted more information on non-lethal wolf deterrents. The Service should ensure ranchers are aware of available information from groups like the International Wildlife Coexistence Network.
Response: We agree that the Service and our partners can increase our outreach and collaboration with local livestock operators to improve the accessibility and implementation of non-lethal wolf deterrents, as described in recovery action 1.6.1. We welcome additional collaboration with organizations and individuals with expertise in this area.

Comment: The new actions do not address flaws with the current management that desensitize wolves to humans and settlements. There is a carcass cache site within a couple of miles of town where wildlife officials drop dead deer and elk. This cache is along a well-traveled road and a quad trail. How successful can a reintroduction program be in the long term if the wolves cannot obtain food on their own and they are perpetually being baited closer to people.
Response: Mexican wolf predation on wild, live prey, primarily elk, has been well documented in the MWEPA, and on other sources of wild prey including small mammals in Mexico. We utilize food caches (road killed deer, elk, or carnivore logs) near den or rendezvous sites of wolves in two management situations, diversionary, to minimize depredations and nuisance situations, and supplemental, to assist animals that have recently been released or translocated to the wild. We carefully consider the placement of food caches for these management scenarios, but they are generally most effective when placed near areas that wolves have chosen and use consistently (e.g., dens and rendezvous sites). We often remove carcasses from areas near people (e.g., small communities, houses) to limit interactions between wolves and humans. We are unaware of the specific situation described by the commenter, but we will continue to work with our partners and the impacted public to minimize interactions between wolves and people.

Public Comments - Education and Outreach
Comment: Site-specific action 1.6.1 is ambiguous and must be amended. It states that FWS will conduct education and outreach “within occupied Mexican wolf range in the MWEPA and other areas where wolves disperse.” It is not entirely clear where these “other areas” are.

Response: We do not know ahead of time where Mexican wolves will disperse, so we have worded the recovery action this way to accommodate future locations within or external to the MWEPA.

Comment: While this effort should prioritize outreach in wolf occupied areas within the MWEPA, it should also include areas outside the MWEPA where wolves may disperse. This is vitally important because, as we have seen multiple times, wolves disperse beyond the arbitrary, human-set MWEPA boundary of Interstate-40. Once a wolf sets paws outside the MWEPA boundary, it is fully endangered and has the highest level of protection under the ESA. It is just as important to educate people about wolf biology and identification outside the MWEPA as it is inside the MWEPA. As written, site-specific action 1.6.1 does not capture this important point and should be amended to clearly state that FWS will conduct education and outreach outside the MWEPA, particularly along Interstate-40.
Response: We have added language to recovery action 1.6.1 to emphasize that areas outside of the MWEPA will also be focal areas for outreach about Mexican wolves.

Comment: Cooperating agencies like the National Park Service, USFS, and Bureau of Land Management all have important roles in protecting endangered species on federal public lands. What are the plans to ensure these cooperating agencies increase their community outreach in parallel with USFWS?
Response: The National Park Service, USFS, and BLM are signatories to the 2019 Memorandum of Understanding on Mexican Wolf Recovery and Management. As such, the Service meets with these agencies and other partners on a regular basis to collaborate on many facets of management, including outreach. We have added these agencies as responsible parties to recovery action 1.6.1.

Comment: Educating the public about the substantial economic taxpayer burden of public lands livestock grazing and the overall impacts of livestock grazing on hunted species is specific information that should be included in public outreach and education. If more people understood the financial support provided to sustain public lands ranching in wolf habitat, as well as the compensatory mechanisms for livestock losses and the impacts livestock grazing has on their interests (water quality, native ungulate populations, forest access, etc.), the wolf recovery program would be put in a fairer perspective. By focusing on conflict-reduction techniques, the Service is unnecessarily endorsing the legitimacy of livestock operations in wolf habitat.
Response: A focus on conflict reduction between wolves and livestock is an important component of our outreach and education efforts because livestock operations occur throughout much of the suitable habitat for Mexican wolves in the MWEPA. Our outreach programs can also incorporate information about the use of public lands for ranching; we will continue to build our materials based on recommendations from the public on the kind of information that would be helpful to understand the context of Mexican wolf recovery.

Comment: It is also important that FWS and cooperating agencies change their messaging regarding where wolves "belong." Currently, the agencies send the message that wolves do not belong in many places suitable for wolves, including the Grand Canyon Ecoregion, Sangre de Cristo Mountains, and San Juan Mountains—all of which are north of Interstate-40. By continually repeating this message the agencies are telling the public that wolves do not and

should not exist in those areas. Not only does this messaging decrease tolerance for wolves there, but it can also give the impression that the agencies do not want wolves there or that they do not exist there. All three of these impressions can lead to increased killing of wolves either because of a lack of tolerance or lack of knowledge. Therefore, the final recovery plan must clearly state that future education and outreach will avoid telling the public that wolves do not exist north of Interstate-40 or that they do not belong there.
Response: We will look carefully at our messaging when we publish public documents or statements that refer to Mexican wolves dispersing north of I-40. The intention of our messaging is typically to describe our strategy to recover Mexican wolves in the MWEPA and to explain how we will manage dispersing wolves that leave the MWEPA, not to decrease tolerance in any location when wolves undertake natural dispersal movements. We have not revised the language in the recovery plan that the commenter is requesting related to messaging above I-40 because that is a superfluous level of detail that is not typical of any of our recovery actions.

Comment: The Service should consider adding a section on increasing the education of and outreach to Wildlife Services agents. Our review of hundreds of depredation investigations provided by Wildlife Services shows that the investigators are woefully uneducated in determining wolf involvement in livestock deaths and they are apparently unable to distinguish whether wolves have scavenged on or killed a dead animal. While we believe this should be in the purview of the US Department of Agriculture to train their own staff, we also recognize unsupportable depredation confirmations and subsequent pressure to remove wolves is a serious issue for the species recovery. At the very least, the Service should convene a panel of third-party experts to review the depredation investigations prior to taking any removal actions. While the Service itself is precluded from making the determinations, any removal that would impact on the wild wolf population must be carefully deliberated in light of the evidence.
Response: As the commentor stated, livestock depredation investigations and confirmations are conducted independently by USDA APHIS Wildlife Services. Therefore, any issues or concerns about depredation investigations should be directed to Wildlife Services.

Comment: It is interesting that only one tribe is a cooperating agency. What might be done to offer more opportunities to tribal members who are interested in the issues affecting Mexican gray wolves? Are there different platforms or forums that might make engaging with the Mexican Wolf Recovery Program more inclusive? How will this be included in community outreach plans?
Response: The Mexican Wolf Recovery Program has established a robust range of communication and coordination opportunities for Tribes that are interested in Mexican wolf recovery. We host the Mexican Wolf Tribal Working Group, which is open to all Tribes, several times a year to foster dialogue about current issues of concern; at times, this group also meets without the Service to maintain the privacy of some discussions. We also attend the bi-annual Tribal coordination meetings held by the New Mexico Ecological Services Field Office and Arizona Ecological Services Field Office, as well as the annual Native American Fish and Wildlife Conference. In addition, we have standing coordination calls with one or more tribes, have invited many tribes to serve as Cooperating Agencies, and we meet with Tribes at their request. We also offer government-to-government consultation pursuant to Secretarial Order 3206 on any policy or regulatory actions we are considering. We do intend to include Tribal outreach in our outreach and educational efforts and expect that there may be additional forms or

platforms that could help us further improve our efforts as we continue to seek additional ways to build relationships with Tribes.

Comment: USFWS should also be considering government transparency in their outreach and communication efforts. What are the plans to ensure needed data and reports are available to interested members of the public? From quarterly reports to annual progress reports and beyond, there often seems to be a delay in updates being made publicly available, sometimes by months or years. How can the public stay informed about the progress of the recovery effort, including data on wolf mortalities, when data is not made public in a timely manner?
Response: We recognize the frustration that our stakeholders and the public have experienced due to our delays in releasing our annual reports or other documents in a timely fashion. Over the last two years we have been exploring ways to improve our timeliness, particularly given our expectation that the MWEPA population will continue to increase/expand demographically and genetically, resulting in more data to record, synthesize, and report. We modified our (previous) monthly reports, which are now quarterly reports, by reformatting them in a manner that allows us to use our database to complete the reports rather than developing content from scratch for every report. Similarly, we are currently modifying the format of the annual reports to make the reports easier to complete. We expect these modifications to drastically improve our timeliness in the future.

Comment: Most folks are not amenable to education and outreach by agents advocating for a program whose success directly results in a negative impact on local ranching operations.
Response: We will continue to conduct education and outreach at events where we are invited but are fully aware that some event organizers will not invite or want our presence. In general, we attempt to provide a balanced approach to presenting information on wolves including presenting the information on impacts to local ranching operations.

Comment: Billboards should be used as an effective, high visibility method to communicate to a large section of the general public, especially on roadways where wolves have been killed by motor vehicles. Again, the implementation details of the messaging campaign are critical and should not be left up to chance. There are very capable public relations firms who can assist in the messaging campaign that Mexican wolves are protected by both state and federal laws, they are valued, ecologically beneficial, and belong on this landscape.
Response: We agree that signage can be an important component of an outreach and education program. We will include this recommendation in our brainstorming and planning to evaluate its potential efficacy.

Comment: This plan seems to focus on education and awareness/outreach but does not give many specifics. It does not state how these efforts are different from what has already been tried (and not worked) in the past two decades or how new materials will affect long-established ranchers. It should provide more clarification on wolf-livestock conflict reduction techniques and wolf-human safety issues given that most opposition for wolf conservation stems from worries about personal safety and the protection of livelihoods. It should provide more information on how funding will be provided for education efforts to be effective.
Response: Some new materials for education and outreach are currently being prepared, and others will be developed in the future; in other words, we expect our expansion of outreach and

education efforts to be a gradual process. More generally, we note that recovery actions are relatively broad statements that describe the actions that will help alleviate threats to the Mexican wolf and achieve recovery criteria, but typically do not provide a high level of specificity. We intend to capture additional specific activities related to this action, and all actions, in our Recovery Implementation Strategy (RIS), which is a separate document that breaks down the broad recovery actions into more discrete tasks. While we intend for the recovery actions to maintain their relevance over the life of the recovery plan, we expect to continuously update the RIS every few years, as feasible, to help us prioritize and adjust our implementation of the recovery actions.

Comment: The Service should provide an easily accessible, comprehensive collection of outreach strategies, goals, and programs made publicly available for this project. Having all of this information in one place would not only allow the public to easily monitor progress, issues, and discrepancies, but allow us to educate ourselves and others in a more digestible and convenient way. As with any issue, it is important to have access to viewpoints from opposing sides.
Response: We will consider this recommendation as we continue to brainstorm and develop our future outreach and educational efforts, and we have included this concept in our description of recovery action 1.6.1.

Comment: The Service should offer grants to talented filmmakers to create educational wolf films on "Front Line", "Nature", or "Nova" using Robert Redford or a more wolf-neutral star to narrate.
Response: The Service and our partners regularly provide film and photography opportunities for members of the media interested in documenting Mexican wolf recovery efforts. Recently, we were featured in a National Geographic documentary series and have also worked with The Washington Post and National Geographic Magazine. There are challenges to filming wild Mexican wolves (remote locations without vehicle access, rough terrain, etc.) that make it difficult to support many filming requests. However, we will continue to seek opportunities to foster and support media partnerships that showcase the recovery effort.

Comment: The Service should bring un-releasable wolves to schools to help educate kids about wolf recovery. This has been done in other areas using wolves from wolf sanctuaries at elementary and middle schools.
Response: The Service uses a variety of educational materials, such as wolf mounts, pelts, and monitoring equipment during outreach events. For safety reasons for both the public and the wolves, we will not bring live wolves to events. However, live wolves can be viewed by the public at a number of zoos and wildlife facilities such as the Albuquerque Biological Park.

Comment: We request that the Service keep impacted communities better informed through more organized outreach and easily accessible community meetings; these meeting could provide monthly updates on wolf action and location which will be helpful in reducing conflict with livestock and humans. We request that the Service increase its engagement with trade organization and member driven groups that represent agriculture and hunting interests. These groups have the opportunity, through their organizations, to disseminate information and

coordinate with communities, which can work to assist the service in working to protect our producers and reducing conflict.
Response: We added language in the description of recovery action 1.6.1 in response to this comment to emphasize the recommendation for community meetings as a method of requested communication.

Comment: The Oregon Department of Fish and Wildlife has an excellent online "quiz" on the differences between wolves and coyotes, which could serve as a guide for a similar tool in Arizona and New Mexico. The state agencies and USFS should also educate hunters of the importance of properly disposing of "gut piles," particularly in areas such as campgrounds, where such attractants can lure wolves into areas utilized by a wide variety of forest users, including campers with dogs. Because the state game and fish agencies and the USFS have a high level of expertise educating and communicating with hunters, trappers, and recreators, they should be the primary agencies responsible for such education and outreach efforts.
Response: We have included AZGFD, NMDGF, and USFS as responsible parties for action 1.6.1. We will share the Oregon Department of Fish and Wildlife quiz with our partners and outreach personnel as an example of a useful outreach and educational tool that could be used for the Mexican wolf.

Comment: Even though the Service had committed to extending community outreach to places like Tonto National Forest and Sitgreaves National Forest, little has been done to accomplish this. Because agencies claim a lack of capacity and the need is to focus on where wolves are concentrated, capacity must be increased. Capacity needs to expand to where the wolves are dispersing. The Service should consider using volunteers with community outreach. This will allow for a broader capacity in the community outreach efforts.
Response: We agree that we have not yet adequately extended community outreach to areas in which wolf occupancy does not regularly occur, which is in part why we have included this as a recovery action (1.6.1) for the Service and our partners. We will continue to build capacity and efficiency by expanding and improving the types of outreach we conduct, which may include the use of volunteers to assist with community outreach.

Comment: There is no discussion of the educational methods that will be employed. For example, will pamphlets/handouts be produced? Will organized learning sessions/classes be implemented? Will mass media be used, including television and radio messaging? How will social media be employed? Who will be responsible for developing a successful educational program? Do those persons have expertise in educational methodologies and public communication? How will assessment of learning be conducted (a reduction in illegal killing of wolves would only be circumstantial evidence of success)? Why is there no planned education of the public regarding the importance of apex predators such as the Mexican wolf in ensuring functioning ecosystems?
Response: These are thought provoking questions that will help us continue to develop and implement education and outreach activities. The Service recently (August 2022) hired a full-time outreach specialist for the Mexican wolf program who has appropriate training and expertise to assist us in our expansion of education and outreach programming for the Mexican wolf. In addition, our partner agencies have considerable expertise in education and outreach efforts. We expect to use a variety of educational and outreach tools, including some of those

mentioned by the commenter, such as written materials (pamphlets/brochures, online information), community education/outreach sessions, development of educational curriculum for school or other groups, and social media and television/radio/newspaper media.

Public Comments - Law Enforcement
Comment: A newly enacted law in Arizona prohibits the Arizona Game and Fish Commission from "prohibiting any person from taking a wolf that is actively threatening or attacking a person, livestock or other domestic animal." This new law is likely to create confusion around wolf killing and in fact seems to encourage wolf killing. Therefore, it is extremely important for the Service, FS, and the state agencies to clearly explain that the Arizona law does not affect the legality of killing wolves because federal law regulates taking of wolves until they are delisted.
Response: The Service and our partner agencies intend to provide ongoing information and clarification to the public about the legal framework under which the Mexican wolf is managed, including the allowable forms of take currently available for Mexican wolves in the MWEPA and external to the MWEPA.

Comment: If the Service would agree to managing the wolf population at a level more acceptable to local stakeholders, and demonstrate its commitment to that level, social tolerance of the Mexican wolf would improve, and greater law enforcement resources would not be needed.
Response: There are many stakeholders in Mexican wolf recovery; these stakeholders have diverse viewpoints on what the abundance and distribution of Mexican wolves should be. The Service has established recovery criteria that address the demographic and genetic threats to the Mexican wolf and is collaborating with partners and stakeholders to develop and implement management and communication strategies to address and reduce conflicts.

Comment: Efforts to reduce illegal take of Mexican wolves should be closely coordinated with state wildlife agencies who provide the vast majority of boots on the ground - their resources are finite and often overextended.
Response: The Service's Office of Law Enforcement coordinates with State, Federal, Tribal, and local entities on actions related to the illegal take of Mexican wolves.

Comment: We recommend law enforcement officers are dually trained to assist in wolf incident response as well as depredation investigations because there are insufficient resources currently to investigate depredations.
Response: USDA-Aphis Wildlife Services currently handles depredation investigations in coordination with the Service and our partners. We appreciate the recommendation for dual training and efficiency and will continue to consider how this concept could be applied for various management needs across the program.

Comment: How does the proposal for increased law enforcement presence compare to previous law enforcement presence? Generally, there is a lack of information on how new efforts to reduce killing are different from previous unsuccessful efforts.
Response: The numbers of law enforcement personnel have varied over time by agency for many reasons related to budget and staffing decisions. As the wolf population grows and expands, the intent is to increase the number of law enforcement personnel and presence in areas

identified as mortality hot spots to assist in public education, deter illegal killing, investigate wolf mortalities, and coordinate with law enforcement from other agencies. We expect the presence of increased law enforcement to have a chilling effect on the intentional illegal killing of Mexican wolves. In addition, increased law enforcement will result in added capacity to investigate mortalities and coordinate actions across jurisdictions.

Comment: In reality the funding allotted for increasing law enforcement will only cover the salaries of two more law enforcement officers. Many more officers are needed to protect the wolves where they roam. We ask that the USFWS amend the plan to include additional law enforcement and funding to accommodate it.
Response: Funding identified for increased law enforcement presence in this recovery plan is an estimate of what is needed for the site-specific management action. Nothing in this plan should be construed as a commitment or requirement that any agency obligate or pay funds. We think the amount we estimated for 1.6.2 is sufficient.

Comment: The USFWS should increase monitoring and enforcement of poaching during hunting seasons for other mammals. Poaching of wolves increases during hunting seasons for other mammals, therefore, requiring more enforcement of poaching during those seasons. Studies suggest that hunting seasons are the deadliest for wolves and increased patrolling and monitoring by enforcement officers would mitigate poaching and increase its detection after it occurs.
Response: The Service's law enforcement personnel assesses trends in illegal killing to determine whether there are locations or times of year when poaching may increase. We will increase our efforts (in both monitoring and enforcement) under recovery action 1.6.2 specifically during hunting seasons for other mammals to address this situation.

Comment: The Service, in cooperation with the public land management agencies, could prohibit the killing of coyotes on public lands in wolf country. Neither Arizona nor New Mexico currently regulate the killing of coyotes, so the states would not lose income from making this change. The Endangered Species Act (ESA) itself has a provision in Subpart E to manage instances of close similarity in appearance of endangered and non-endangered species [50 CFR Part 17 Subpart E - Similarity of Appearance (§§ 17.50 - 17.52)].
Response: A section 4(e) "similarity of appearance" listing would be a separate regulatory action under the ESA and is therefore beyond the purview of the recovery plan. Mexican wolves and coyotes may be difficult to distinguish at a distance or quick glance, however, there are many distinguishing differences between the two. Mexican wolves weigh two to three times more (50-80 lbs.), have larger blockier heads with shorter, more rounded ears, and measure 5.5 feet from snout to tail. Coyotes typically weigh 30-40 lbs., have smaller, more pointed heads, larger ears, and measure 3-4 feet long. The morphological differences should allow people to properly identify a wolf and coyote when shooting through a scoped rifle or at close distances.

Public Comments - Miscellaneous
Comment: USFWS assumes that the Mexican wolf population will grow or remain stable if the mean adult mortality rate is less than 25 percent. However, some of the world's best wolf scientists indicate that an estimated annual rate of human-caused losses must average less than 20 percent over an 8-year period as measured by a statistically reliable monitoring effort. There

is a significant discrepancy between the modeling assumptions being used by USFWS and the recommendations of independent scientists. USFWS should use the more conservative modeling assumptions to ensure that high human-caused mortality does not jeopardize recovery efforts.
Response: The Service's estimation of the level of mean adult mortality at which the population will increase, decrease, or remain stable is based on the results of the population viability assessment that was conducted as part of the development of the 2017 recovery plan (Miller 2017). The modeling effort utilized the most comprehensive collection of Mexican wolf data available and is therefore a more appropriate basis upon which to manage Mexican wolves than broader recommendations from scientists studying wolves in other areas.

Comment: The Service should flip this model on its head and provide wolf compensation programs (i.e., quid pro quo releases for every unlawful wolf mortality) and remove the non-native cows through compensated permit retirement, and thereby reduce the "stressors" of habitat availability and suitability. We encourage the Service to consider this as an integral piece of reducing human-caused mortality and other forms of management interference in these animals' lives. Reducing livestock in wolf habitat reduces livestock-wolf conflict, reduces the pressure for management removal of wolves accused of predation, and over time, reduces the cost of compensation programs for lost livestock. The Service should add permit retirement to its recovery budget.
Response: Public lands grazing permits in areas of suitable habitat for the Mexican wolf in the MWEPA are regulated by the FS rather than the Service; therefore, this recommendation is beyond the purview of the Service to implement.

Comment: The new actions are not site-specific (except for one in Mexico). As an example, a high number of wolves have been found illegally killed and a high number of radio-collared wolves in particular have also disappeared in the Beaverhead and adjoining Collins Park areas of the Gila National Forest, north of the boundary of the Gila Wilderness. (This is one of several identifiable regions in which such illegal mortality can be inferred from publicly available data including most notably the Service's irregular but longstanding postings of wolf locations online, which collectively show home ranges for wolves who subsequently are reported dead or missing.) Thus, action 1.6.2, Increase law enforcement presence in areas identified as mortality hot spots to assist in public education, deter illegal killing, investigate wolf mortalities, and coordinate with law enforcement from other agencies, should have identified a site that is one of those hot spots as Beaverhead/Collins Park.
Response: We explain in the recovery plan that we may not identify specific geographic areas, such as the name of a town, County, or National Forest but rather provide qualitative locations for some of the recovery actions. We take this approach because the future locations of conflicts may not be known, or because locations may change over time. For example, a current hot spot of depredation or illegal killing today may not be a hot spot in a few years.

Comment: Given the inordinate genetic value for both wild populations of Mexican wolves of potential connectivity between those in the U.S. and in Mexico – acknowledged too-briefly in action 3.3, Maintain and enhance connectivity within and between Mexican wolf populations, and given the border wall that restricts where wolves can cross, and other habitat information, the Service should be able to identify specific sites along I-10 for its action 1.6.3: Install enhancements to facilitate Mexican wolf movement across existing and new roads and reduce

vehicle collisions with Mexican wolves in occupied range, especially in areas likely to serve as corridors.
Response: Facilitating movement across existing and new roads is accomplished during construction or improvement of new and existing roadways. The Service and/or partners will have to collaborate with the highway departments to accomplish this goal during construction projects. Dispersing wolves move in an unpredictable fashion relative to territorial wolves. Our experience suggests that while we can predict where wolf territories will be established, wolves will utilize virtually all habitats while dispersing long distances. Enhancements utilized by large animals such as deer and elk will also be utilized by wolves and minimize costs to people from vehicle/animal impacts. We will continue to monitor wolf movement patterns and determine if recommendations can be made to highway departments specifically related to wolves.

Comment: Coexistence measures must be required of all livestock owners who use our public lands. There are many tried and true methods that need to be specified in the plan. No compensation for depredations should be paid to any livestock operator who did not make use of all non-lethal conflict avoidance strategies. The livestock owners who use public lands should bear the burden of conflict reduction, not the wolves.
Response: Public lands grazing permits in areas of suitable habitat for the Mexican wolf in the MWEPA are regulated by the FS rather than the Service; therefore, this recommendation is beyond the purview of the Service to implement.

Comment: Is there a commitment from the entities listed as Responsible Parties to contribute funding to implement the actions?
Response: A recovery plan does not commit any party to contribute funding to implement recovery actions. However, the Service and our partners hold coordination meetings at least bi-annually to discuss priorities, which typically includes discussion of each party's ability to maintain, expand, or contribute funding to various actions.

Comment: We urge USFWS to include the Arizona Livestock Loss Board as a responsible party to take part in implementing Recovery Action 1.8.1.
Response: The Arizona Livestock Loss Board serves as a funding mechanism to provide compensation for depredations in Arizona rather than a boots-on-the-ground entity to implement specific actions.

Comment: The Recovery Plan clearly elevates paying public lands lessees above conducting education and outreach and increasing law enforcement presence. Implementing livestock conflict avoidance at $220,000 annually and providing funding for wolf-livestock conflict avoidance at $240,000 annually are approximately double the amounts for the former. To help compensate for this disparity, the Service should coordinate with USFS and BLM to adjust authorized stockage levels progressively downward each year for hotspots/problem allotments. Regardless of the possible multiple causes of the conflicts, fewer livestock each year would result in fewer conflicts with wolves. Similarly, funds for depredation compensation should be reserved for lessees who avail themselves of non-lethal conflict avoidance measures.
Response: The commenter correctly notes that public land grazing leases are the regulated by USFS and BLM and reduction in numbers is beyond the purview of the Service. We do discuss potential temporary movements of cattle away from denning or rendezvous sites with the USFS,

BLM, and/or livestock Permittees as one method to limit depredations. All parties (NGO's, livestock Permittees, the Service and partner agencies) employ a wide variety of methods to limit the number of depredations to prevent economic losses to permittees and removal of wolves. Removal of wolves for livestock depredation is the same as a mortality to the population. These actions (education and outreach, law enforcement, wolf-conflict avoidance) are not mutually exclusive actions, but rather synergistic efforts that should compliment one another.

Comment: We are alarmed at the listing of "carnivore logs," defined as a "commercially manufactured raw horse meat-based diet," as a primary source of diversionary food caches. Since there are no active horse slaughter plants in the United States–and even if there were–we are concerned about the sourcing of the horse meat for diversionary feeding. Will this result in New Mexico's exported horses being imported back to the United States as meat to feed wolves?
Response: The Service is not involved in the production of the carnivore logs that we use to feed Mexican wolves during certain management operations. Therefore, we do not know the fate of wild horses exported from New Mexico to other locations.

Comment: The Service needs to provide technology to ranchers to alert them, on a daily basis, about wolf movements on or near their ranches. Receivers currently used are inadequate; ranchers need a software application that identifies presence and movement in real time on their ranch and within a day's movement of that ranch. This is the only way ranchers can hope to manage their livestock to avoid depredations.
Response: We are looking into available and evolving technologies that can help us alert ranchers in a timely fashion to wolf movements on or near their ranches or allotments. We do not have a timeframe currently set for when or how we may adapt our current practices.

Comment: The Service should identify in detail how it plans to document the wolf population for action 1.1.1, given the presence of un-collared wolves and wolf hybrids.
Response: We provide information about our methodology for documenting the size of the wolf population in our annual reports after we conduct the minimum population count in late winter every year.

Comment: The total cost of the recovery effort is hard to support, given the time, money, and results that have currently been spent and achieved.
Response: We recognize the high cost of Mexican wolf recovery compared to some other endangered species conservation efforts. We have developed a strategy to recover the Mexican wolf that will ensure an efficient path forward.

Comment: Indigenous tribes especially those in the Mexican Wolf Experimental Population Area should be included and consulted as their diverse views are important for the recovery of the Mexican Gray wolf. Their views should be honored and become a larger part of the recovery program.
Response: We agree. We established the Mexican Wolf Tribal Working Group over a decade ago; this group is open to all tribes and is a forum to discuss issues of interest and concern to Tribes related to the conservation and management of Mexican wolves. This group developed a white paper to describe the range of perspectives and concerns of the tribes, "Tribal Perspectives on Mexican Wolf Recovery." In addition, we offer government-to-government consultation

pursuant to Joint Secretarial Order 3206 for all significant actions that we undertake, such as revising the management regulations for the MWEPA or revising the recovery plan.

Comment: The timeline for recovery actions in the recovery plan seems excessive (too long); adaptive management should be employed to ensure the Service is on an efficient path toward recovery.
Response: We agree that adaptive management is a critically important approach to recover the Mexican wolf due to the controversial nature of the program, various scientific uncertainties, and the cost of implementing recovery actions. The timeline in the recovery plan accounts for the needed recovery actions to take place in both the U.S. and Mexico; while our estimate of the time it will take to recover the Mexican wolf is to some degree uncertain, we have based our estimates of time on our knowledge of the population growth we expect from both the U.S. and Mexico populations, and the amount of time it will improve the gene diversity of both.

Comment: Clarify how the population objective will be counted.
Response: The demographic recovery criterion will be determined using a running geometric mean (or, average). We are already calculating the running average every year; the example in the recovery plan was simply an illustration of possible population sizes that would achieve the demographic recovery criterion, it was not intended to portray a specific year in which we would start counting the population size toward the criterion.

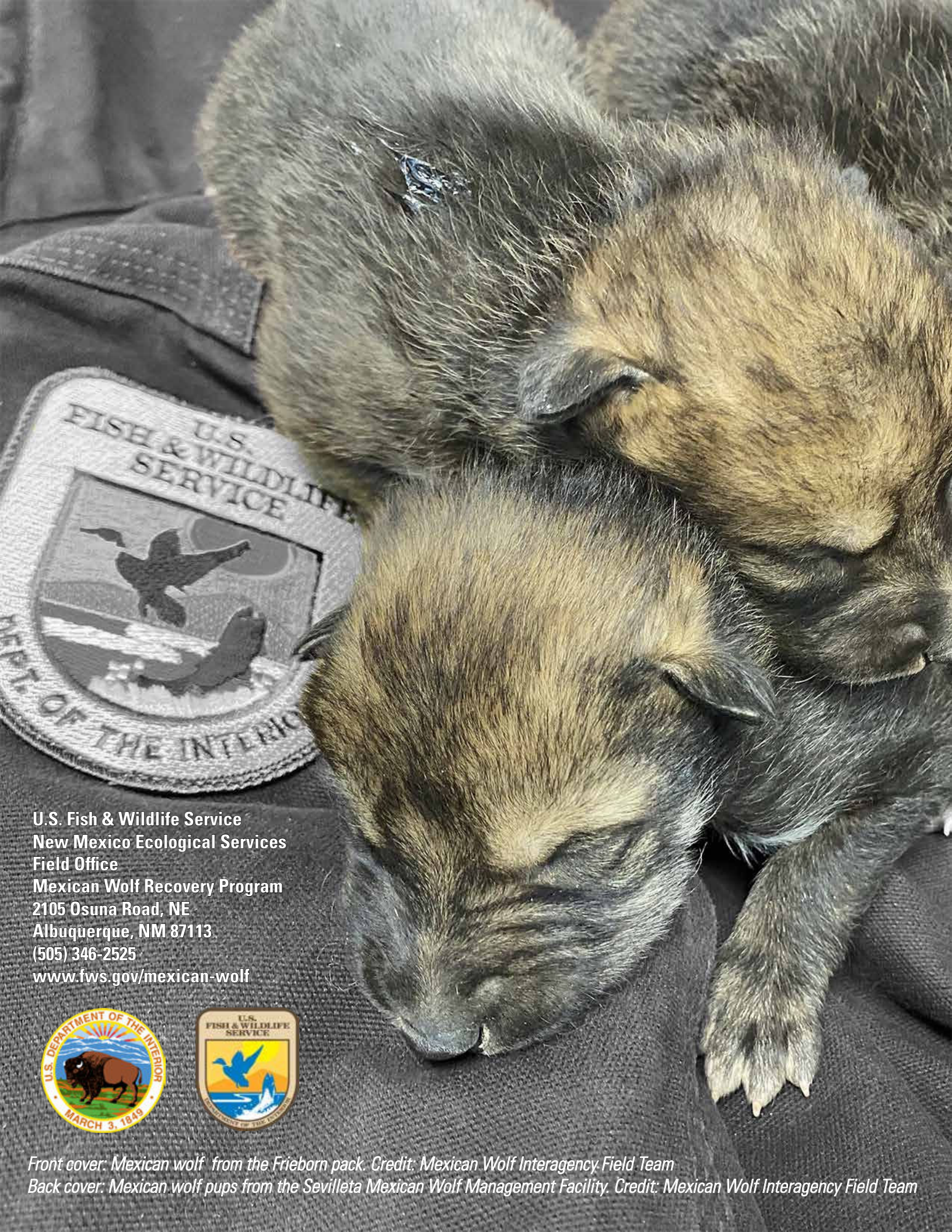
Comment: The Second Revision establishes 320 as the target wolf population, yet like the first version, continues to wait until the wolf population exceeds 380 before allowing management actions. If the Service is truly committed to "any and all management options" to maintain social tolerance, the Second Revision should automatically trigger appropriate management actions when the population exceeds the target level of 320. This will give stakeholders the assurance they need that wolf overpopulation issues will be addressed and will increase the social tolerance that is crucial to Mexican wolf recovery success.
Response: We will manage conflict situations between wolves and livestock or people at all population sizes; we will not wait until the population reaches 380 to allow or conduct management actions. Our current management actions include non-lethal management activities to reduce the likelihood of depredations or respond to conflict, harassment, and lethal take if necessary. These management actions are defined and regulated by our MWEPA regulations pursuant to section 10(j) of the Act (87 FR 39348-39373, July 1, 2022).

Comment: There is no plan on how FWS intends to acquire the funds necessary to implement the site-specific actions.
Response: The cost of recovery actions may be borne by any entity that is contributing to the implementation of the recovery plan; the Service does not secure funding for all recovery actions. We will continue to collaborate with our partners to secure funding for recovery actions as our budgets and priorities allow. We will also look for grants and other funding opportunities.

Comment: Site-specific action 1.6 is ambiguous and must be clarified in the final recovery plan. FWS estimates that the action will cost $134,000 annually. The action includes education and outreach, identification of areas where enhancements are needed, installation of enhancements to facilitate safe passage, and maintenance of Mexican gray wolf habitat. It is unclear if the

$134,000 also includes the cost of 1.6.2—increase law enforcement presence in mortality hotspots—or if FWS intends to spend an additional $134,000 on law enforcement annually. The final recovery plan must clarify this ambiguity.
Response: We have clarified that the cost of action 1.6.1 is included in action 1.5. We have clarified that the cost of action 1.6.2 in FY18 ($134,000) is included in the total cost of 1.6. in FY18. We have clarified that $3,350,000 of the total cost of 1.6 is for action 1.6.2.

Comment: The final recovery plan must explicitly state that legislation and/or regulations to maintain the demographic and genetic delisting criteria must be promulgated before the Service will proceed with delisting the Mexican gray wolf.
Response: A recovery criterion is already in place in the recovery plan to address this comment.



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Front cover: Mexican wolf from the Frieborn pack. Credit: Mexican Wolf Interagency Field Team
Back cover: Mexican wolf pups from the Sevilleta Mexican Wolf Management Facility. Credit: Mexican Wolf Interagency Field Team