Mexican Gray Wolf

April 19, 2024
Silver City, NM

History of Mexican Wolf

- **Most genetically distinct subspecies of North American Gray Wolves**
- **Core population in the montane woodlands of Southern NM/AZ and Northern Mexico**
- **Extirpated from the US in the early 1970's**
- **Listed as an endangered species in 1976**
- **Captive breeding program established in 1977 to 1980**

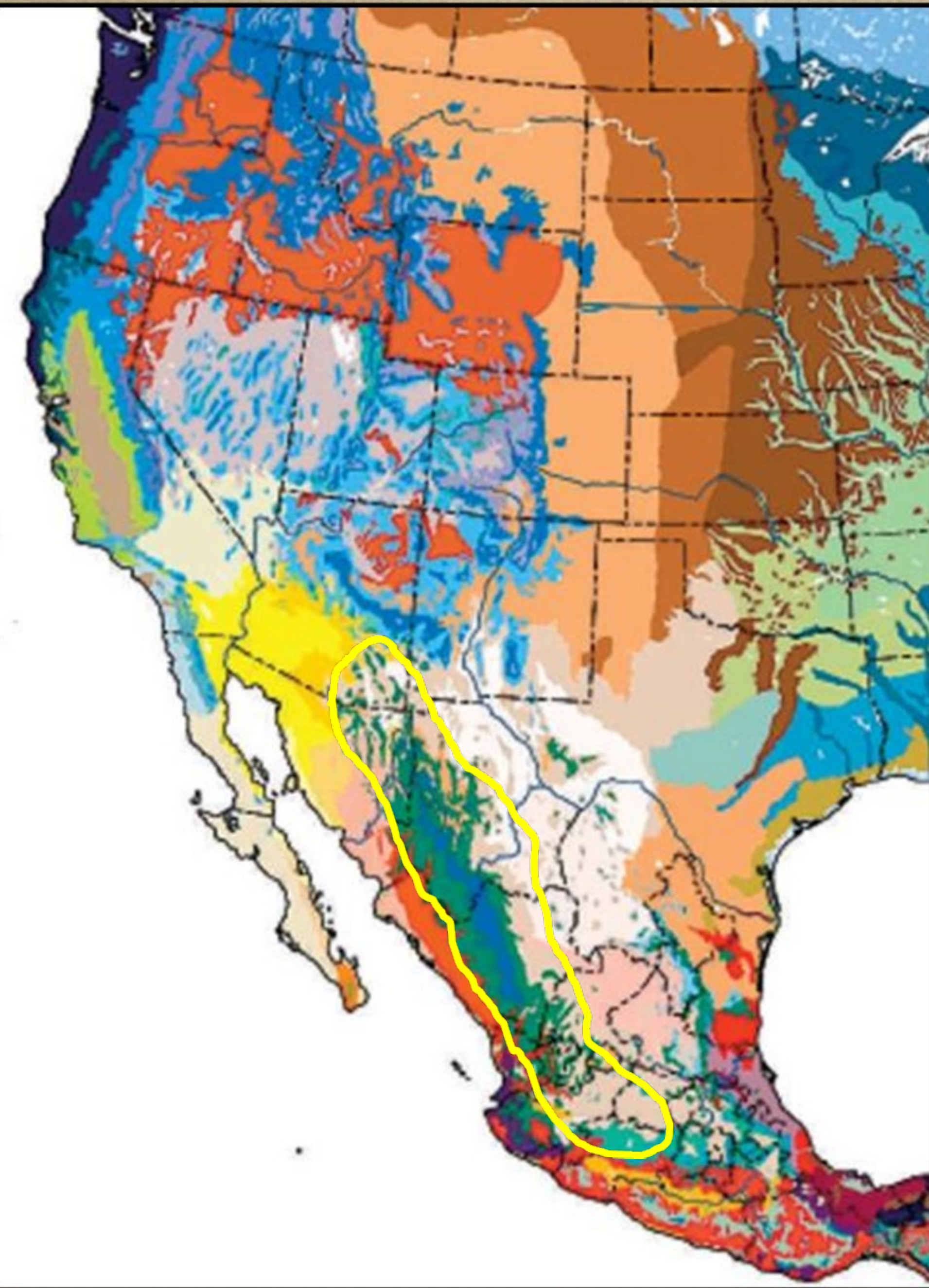
SAFE Program

- Created with the last remaining wild wolves
- 60 facilities across US/Mexico
- 3 Pre-release facilities in the US
- Originally source for re-establishing populations
- Today provide for inserting genetic diversity into wild population

Photo Credit: USFWS

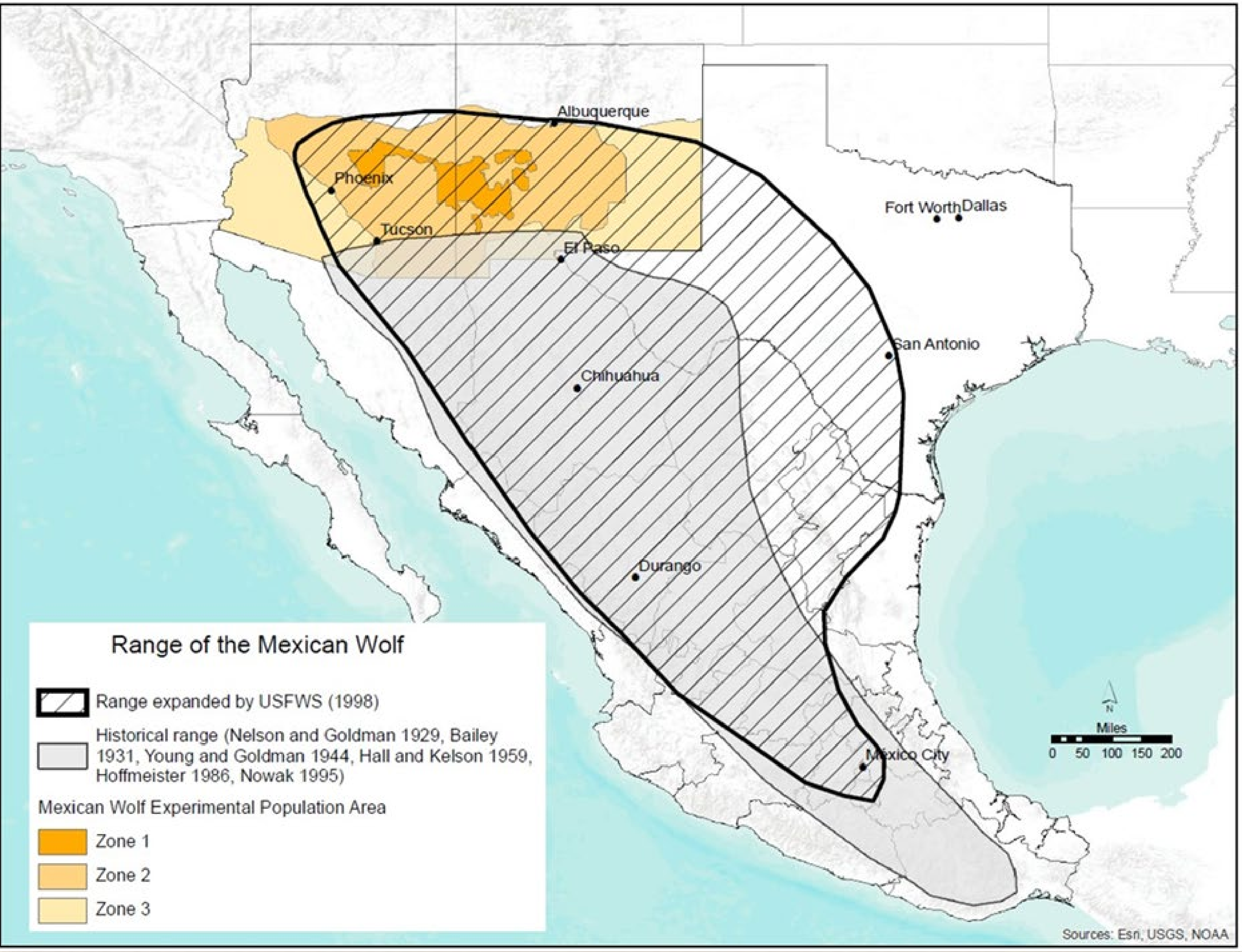
Mexican Wolf Distribution: "Southern and western Arizona, southern New Mexico, and the Sierra Madre and adjoining tableland of Mexico as far south, at least, as southern Durango."

Nelson and Goldman 1929



Mexican Wolf historical range aligns with major differences in Ecoregions

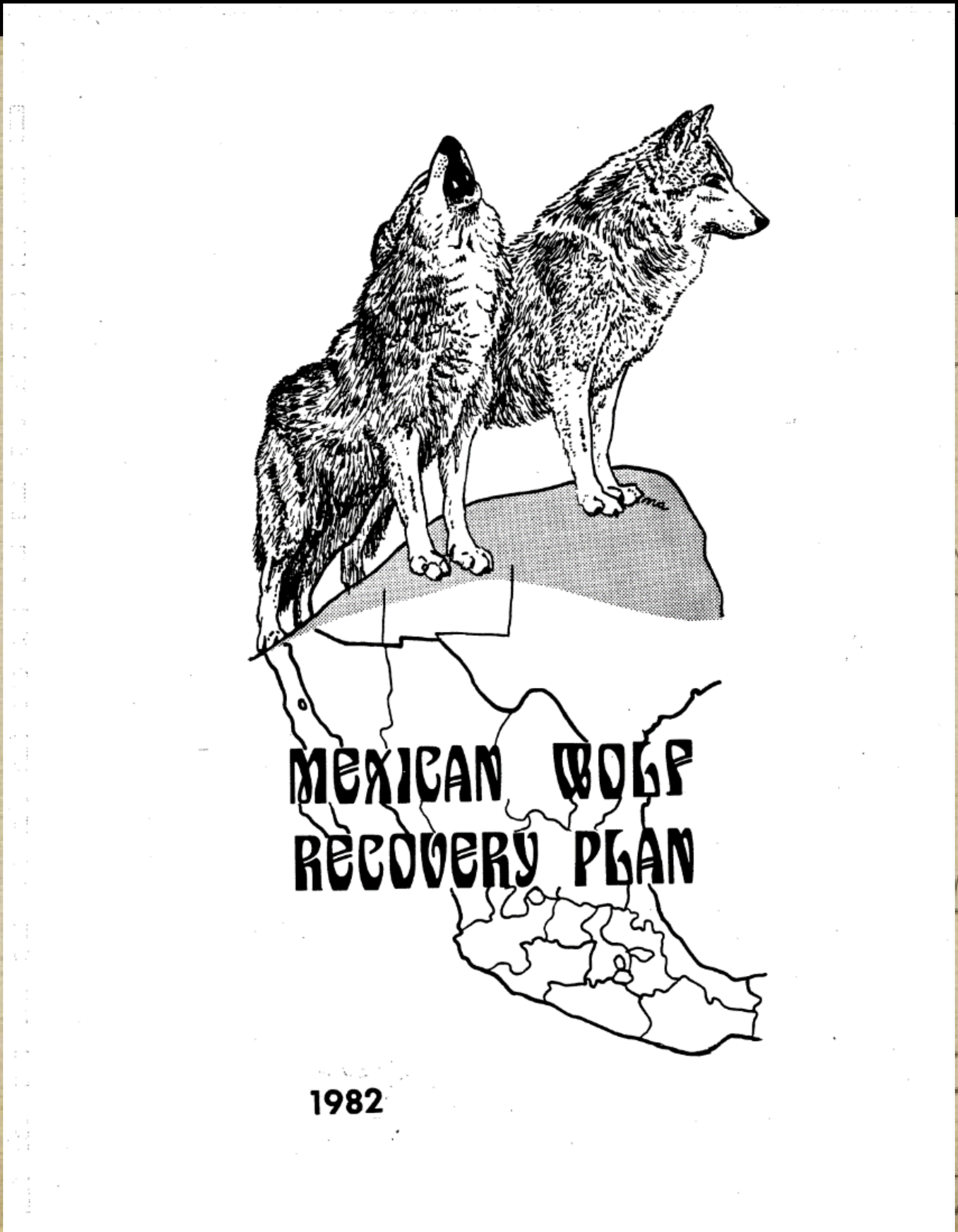
Where to Recover Mexican Wolves



New Mexico Department of Game & Fish

Recovery Plans

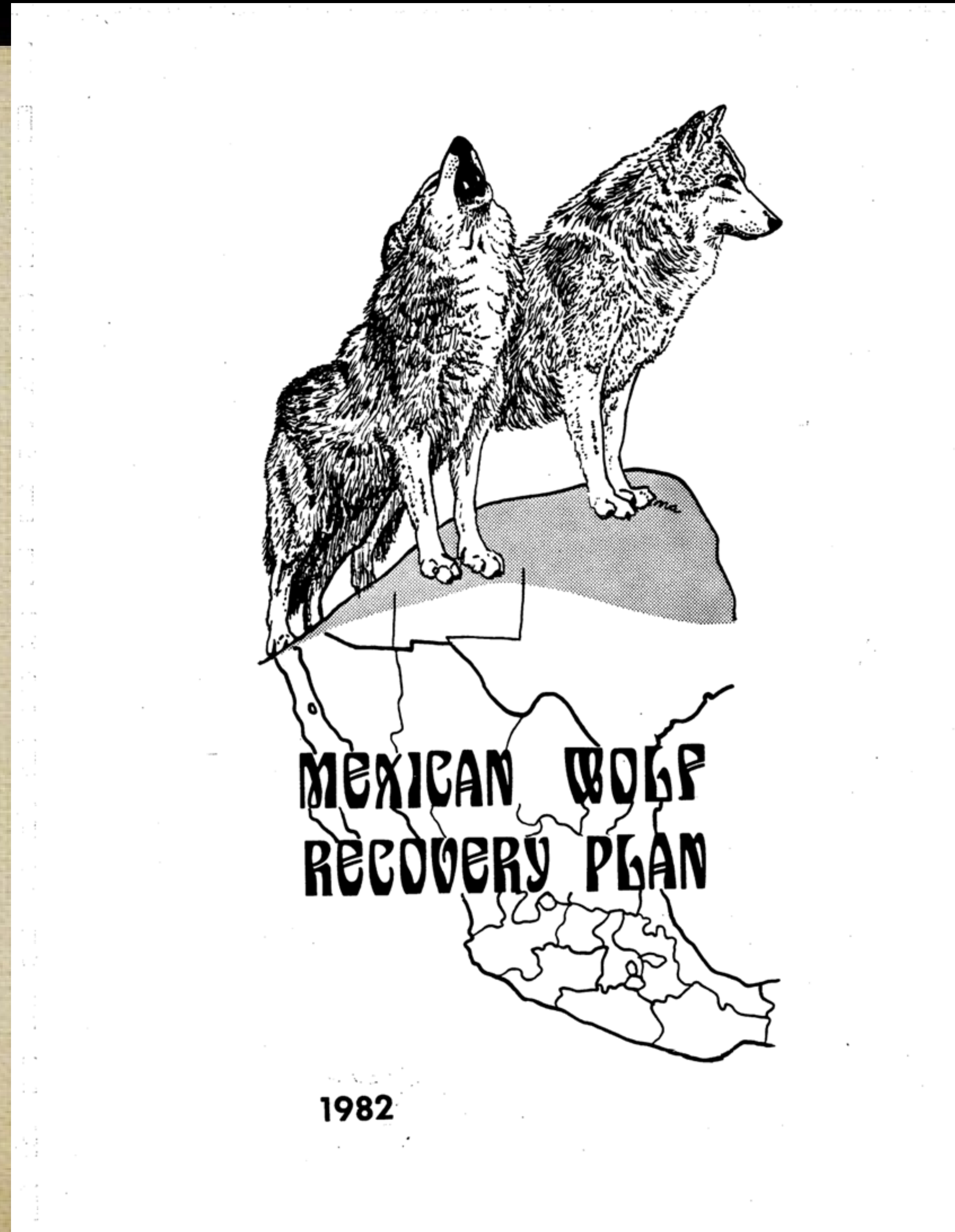
- Written in 1982
- No delisting criteria
- No population goal



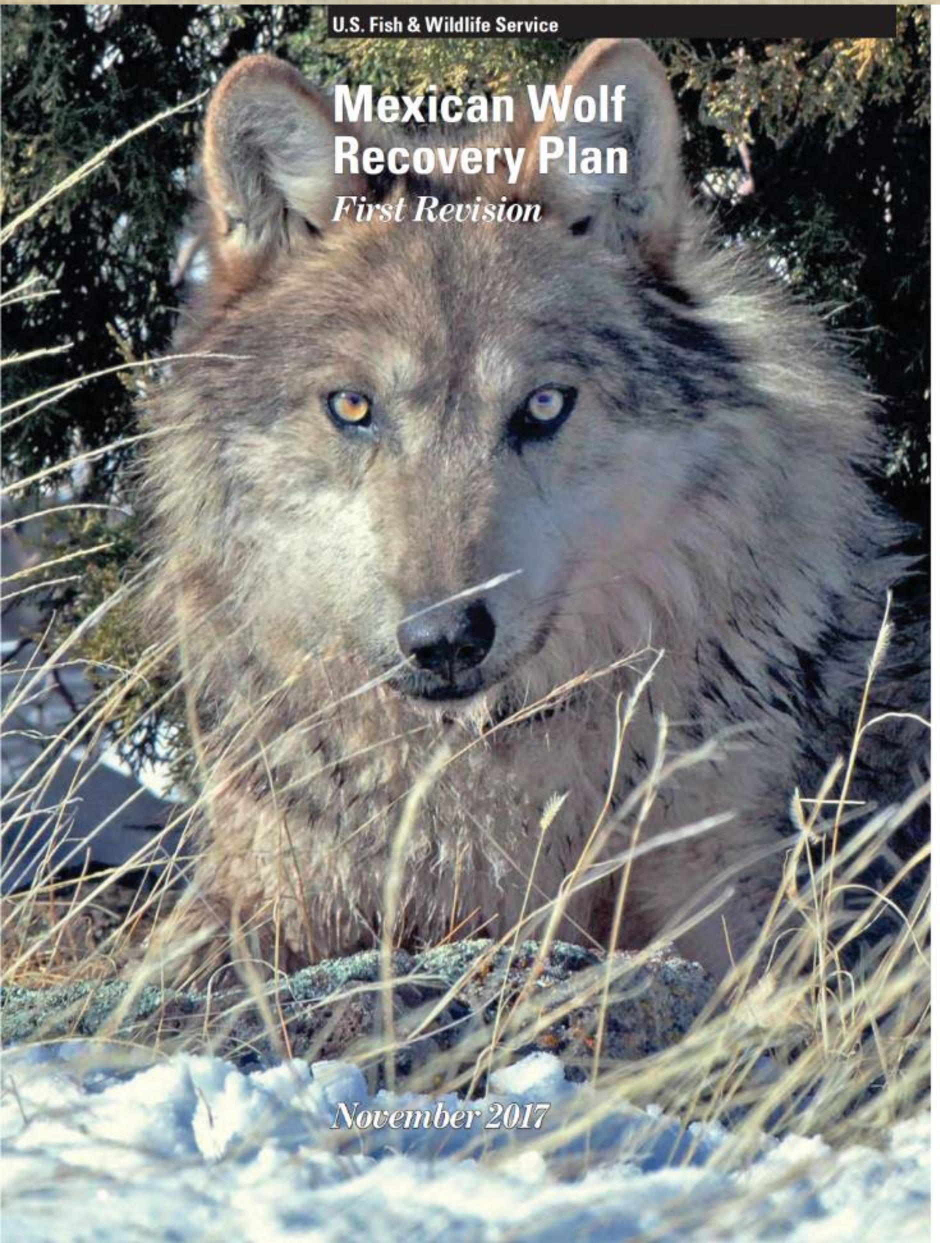
New Mexico Department of Game & Fish

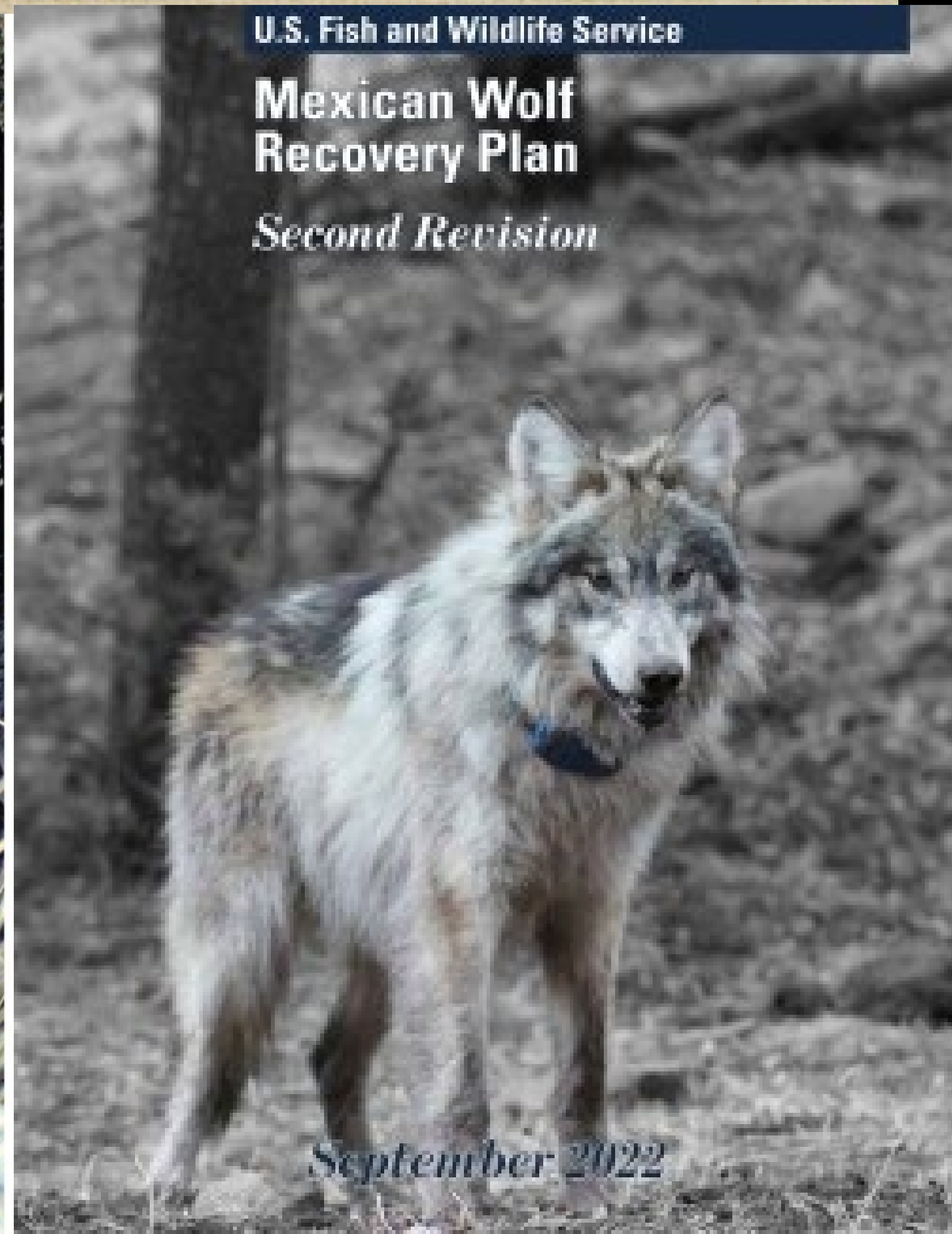
Previous Attempts to Update

- 1995
- 2003
- 2010



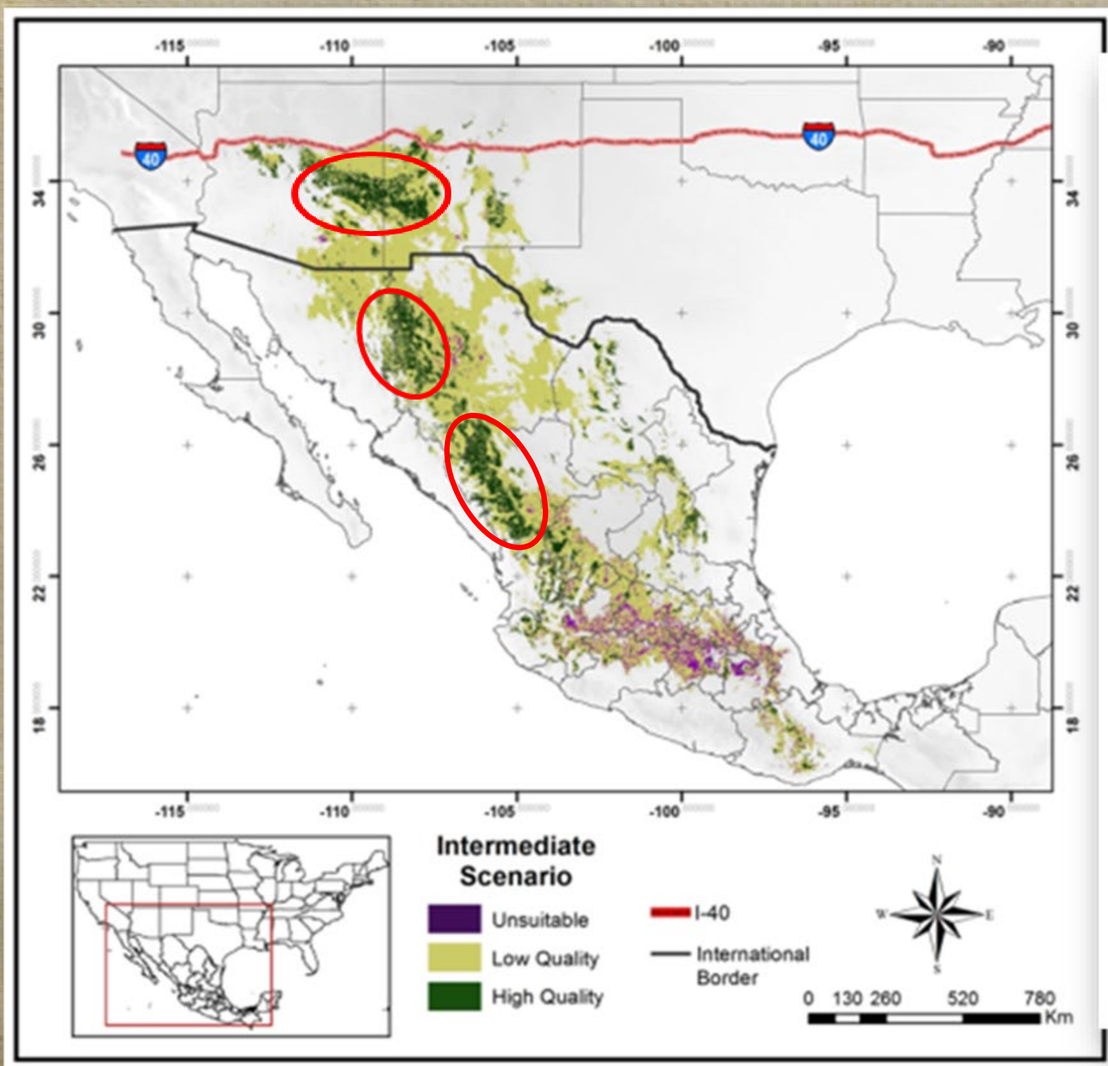
New Mexico Department of Game & Fish

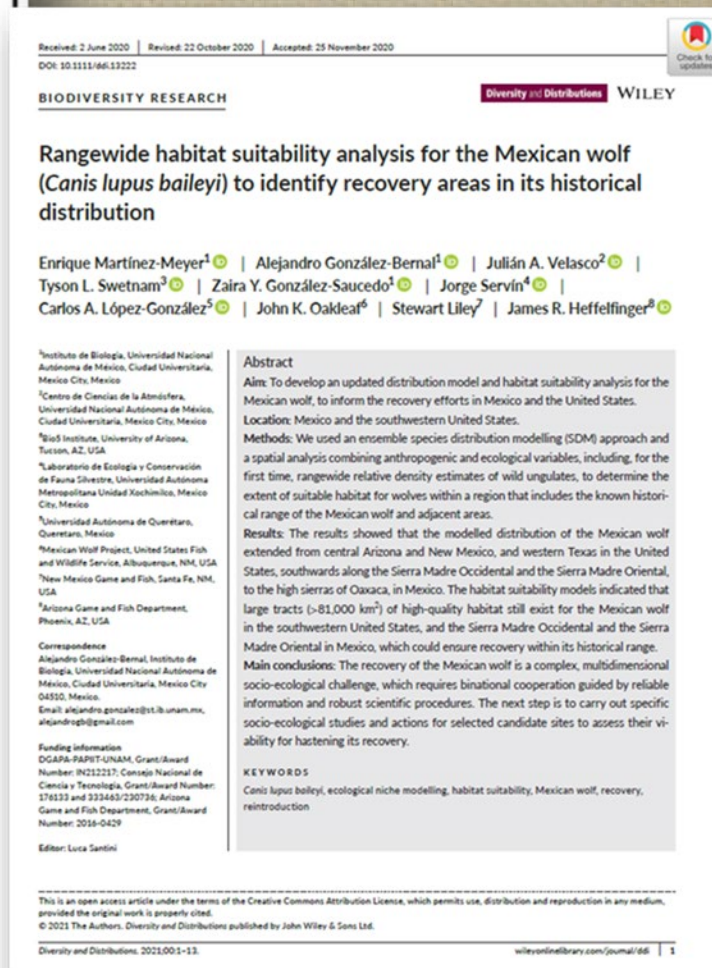

U.S. Fish & Wildlife Service
Mexican Wolf
Recovery Plan
First Revision
November 2017


U.S. Fish and Wildlife Service
Mexican Wolf
Recovery Plan
Second Revision
September 2022

Binational Effort

Habitat Suitability





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BIODIVERSITY RESEARCH

Diversity and Distributions WILEY

Rangewide habitat suitability analysis for the Mexican wolf (*Canis lupus baileyi*) to identify recovery areas in its historical distribution

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Editor: Luca Santini

Abstract

Aim: To develop an updated distribution model and habitat suitability analysis for the Mexican wolf, to inform the recovery efforts in Mexico and the United States.

Location: Mexico and the southwestern United States.

Methods: We used an ensemble species distribution modelling (SDM) approach and a spatial analysis combining anthropogenic and ecological variables, including, for the first time, rangewide relative density estimates of wild ungulates, to determine the extent of suitable habitat for wolves within a region that includes the known historical range of the Mexican wolf and adjacent areas.

Results: The results showed that the modelled distribution of the Mexican wolf extended from central Arizona and New Mexico, and western Texas in the United States, southwards along the Sierra Madre Occidental and the Sierra Madre Oriental, to the high sierras of Oaxaca, in Mexico. The habitat suitability models indicated that large tracts (>81,000 km²) of high-quality habitat still exist for the Mexican wolf in the southwestern United States, and the Sierra Madre Occidental and the Sierra Madre Oriental in Mexico, which could ensure recovery within its historical range.

Main conclusions: The recovery of the Mexican wolf is a complex, multidimensional socio-ecological challenge, which requires binational cooperation guided by reliable information and robust scientific procedures. The next step is to carry out specific socio-ecological studies and actions for selected candidate sites to assess their viability for hastening its recovery.

KEYWORDS
Canis lupus baileyi, ecological niche modelling, habitat suitability, Mexican wolf, recovery, reintroduction

Mexican Wolves North?

Biological Conservation 220 (2018) xxx–xxx

Contents lists available at ScienceDirect

Biological Conservation

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Perspective

Perils of recovering the Mexican wolf outside of its historical range

Eric A. Odell[a,*], James R. Heffelfinger[b], Steven S. Rosenstock[b], Chad J. Bishop[c], Stewart Liley[d], Alejandro González-Bernal[e], Julián A. Velasco[f,g], Enrique Martínez-Meyer[e,h]

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Letter to the editor

Genetic rescue, not genetic swamping, is important for Mexican wolves

ARTICLE INFO

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Letter to the editor

Reply to Hedrick et al.: The role of genetic rescue in Mexican wolf recovery

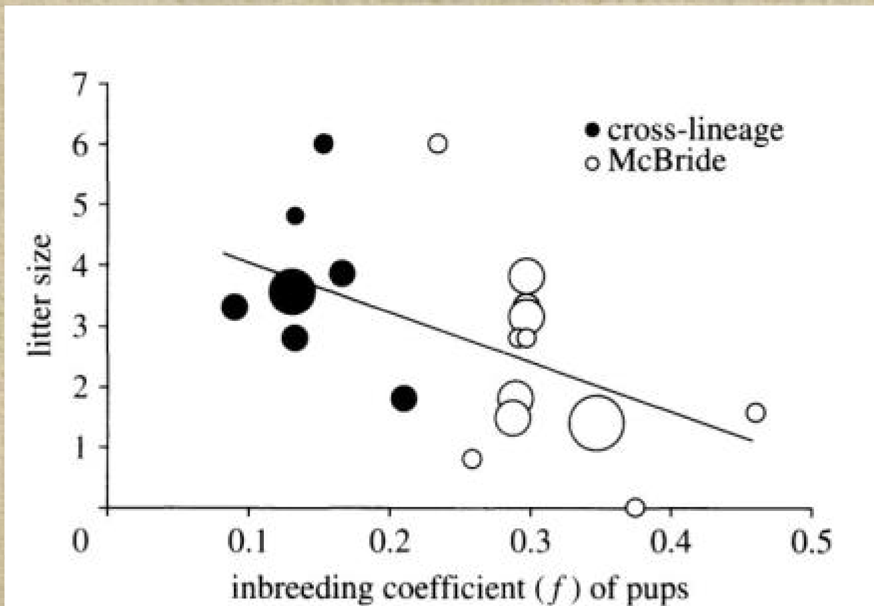
New Mexico Department of Game & Fish

Biological Info

- Update with current data
- Examine extinction risk
- Determine necessary numbers

New Mexico Department of Game & Fish

Initial Genetic Diversity Concerns



39 litters (1998-2006)

PROCEEDINGS OF THE ROYAL SOCIETY B

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Genetic rescue and inbreeding depression in Mexican wolves

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Although inbreeding can reduce individual fitness and contribute to population extinction, gene flow between inbred but unrelated populations may overcome these effects. Among extant Mexican wolves (*Canis lupus baileyi*), inbreeding had reduced genetic diversity and potentially lowered fitness, and as a result, three unrelated captive wolf lineages were merged beginning in 1995. We examined the effect of inbreeding and the merging of the founding lineages on three fitness traits in the captive population and on litter size in the reintroduced population. We found little evidence of inbreeding depression among captive wolves of the founding lineages, but large fitness increases, genetic rescue, for all traits examined among F_1 offspring of the founding lineages. In addition, we observed strong inbreeding depression among wolves descended from F_1 wolves. These results suggest a high load of deleterious alleles in the McBride lineage, the largest of the founding lineages. In the wild, reintroduced population, there were large fitness differences between McBride wolves and wolves with ancestry from two or more lineages, again indicating a genetic rescue. The low litter and pack sizes observed in the wild population are consistent with this genetic load, but it appears that there is still potential to establish vigorous wild populations.

Keywords: conservation genetics; genetic rescue; inbreeding; inbreeding depression; wolves

1. INTRODUCTION

Inbreeding reduces the fitness of wild (Keller & Waller 2002), captive (Ralls *et al.* 1988) and experimental populations (Lacy *et al.* 1996), and increases the risk of population extinction (Newman & Pilson 1997; Saccheri *et al.* 1998). Inbred populations may have fitness restored by immigration of unrelated individuals (Wang *et al.* 1999; Whitlock *et al.* 2000), a phenomenon termed 'genetic rescue' (Tallmon *et al.* 2004). Support for genetic rescue comes from experiments in which fitness was increased following translocation of outbred individuals into small, declining wild populations with low fitness (Westemeier *et al.* 1998; Madsen *et al.* 1999, 2004; Hogg *et al.* 2006). Populations with a history of small size may have a high fixed, or nearly fixed, load of deleterious alleles, and the detrimental effect of additional inbreeding may be limited (Hedrick 1994; Hedrick & Kalinowski 2000). Small populations isolated from one another, however, are expected to become fixed for deleterious alleles at different loci. In this case, crosses between inbred populations may produce offspring with increased fitness, resulting in genetic rescue. Whereas the effects of inbreeding in small populations may be a cause for concern among conservation managers, the prospect of fitness restoration and reduced extinction risk resulting from renewed gene flow may offer new conservation opportunities.

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Mexican wolf (*Canis lupus baileyi*), an endangered subspecies of grey wolf, is the most genetically distinct subspecies in North America (Leonard *et al.* 2005). Human activities throughout its range reduced and isolated Mexican wolf populations such that by 1925 they were rare in the United States (Brown 1983), and by the 1950s their range and numbers in Mexico were greatly reduced (Leopold 1959). By 1980, fewer than 50 wild Mexican wolves were thought to remain in isolated groups spread across four Mexican states (McBride 1980). Surveys in Mexico since then have failed to detect Mexican wolves.

All Mexican wolves alive today originated from three captive lineages founded between 1961 and 1980 by a total of seven wolves (Hedrick *et al.* 1997). These lineages were managed independently until 1995 when the Aragón and Ghost Ranch lineages were merged into the McBride lineage (Hedrick *et al.* 1997). By this time, each lineage had accumulated substantial levels of inbreeding (see the electronic supplementary material, figure S1) and the heterozygosity at microsatellite markers was about one half of that observed in northern grey wolves (Wayne & Vila 2003).

Pairings between lineages began in 1995 with the first F_1 pups (those resulting from pairings between lineages) being born in 1997 (figure S1). Since then, F_1 wolves have been bred among themselves, backcrossed to McBride wolves, and bred with cross-lineage wolves (wolves with ancestry from two or more lineages other than F_1 wolves). The initial goal was for the merged population to have 10% of its ancestry from each of the Aragón and Ghost Ranch lineages. Upon review of the fitness effects of the

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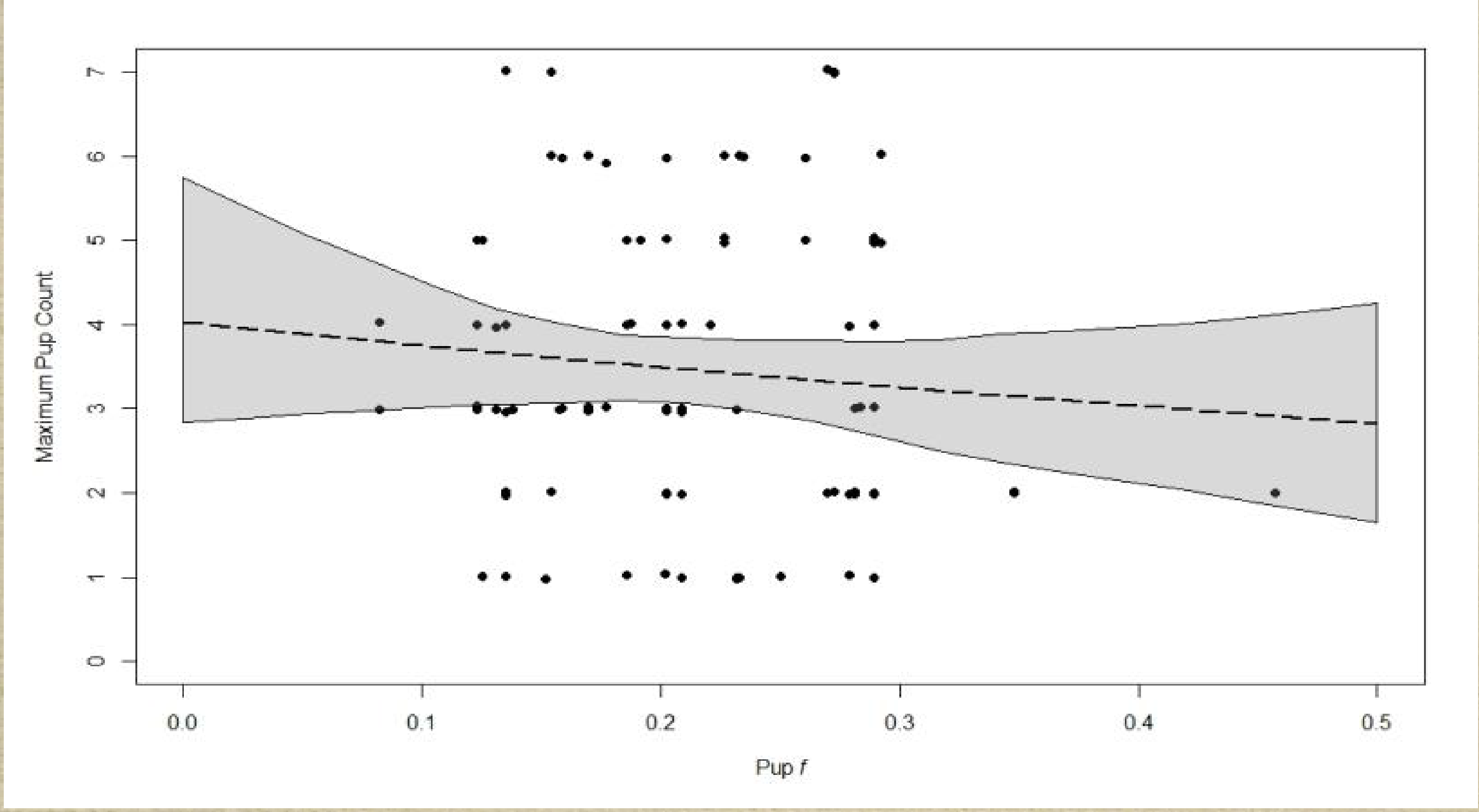
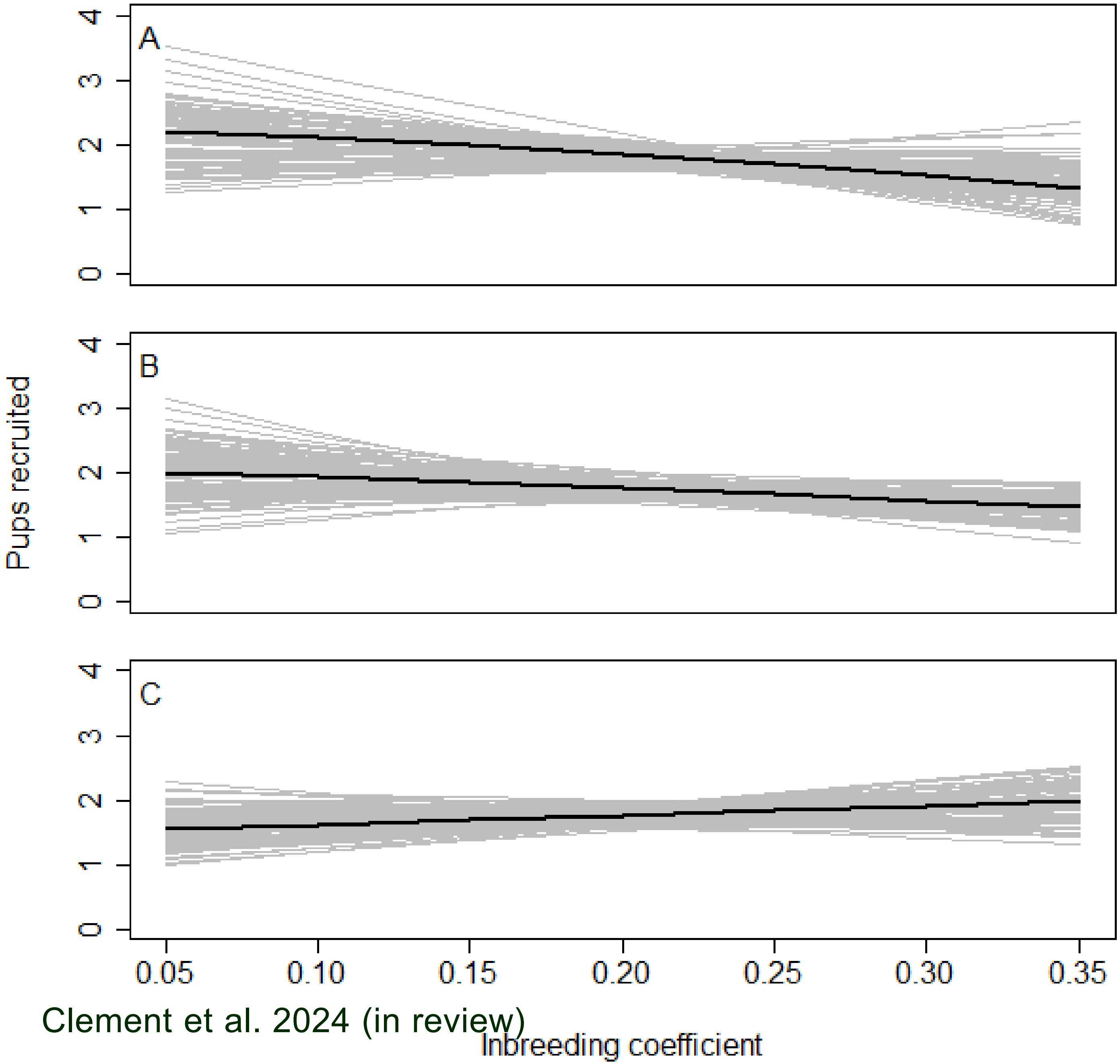
Updated Analysis of Inbreeding Effects



89 litters - 1998-2014 (50 more litters and 8 more years)

New Mexico Department of Game & Fish



Clement et al. 2024 (in review)

New Mexico Department of Game & Fish

Wolf pup fostering

Fostering Success

99 captive-born pups added to the wild dens

At least 18 have attained breeding age

At least 10 fostered pups produced at least 20 litters

Several of the offspring from fosters have produced pups of their own

Recovery Criteria

Minimum of two populations meeting abundance and genetic criteria

United States

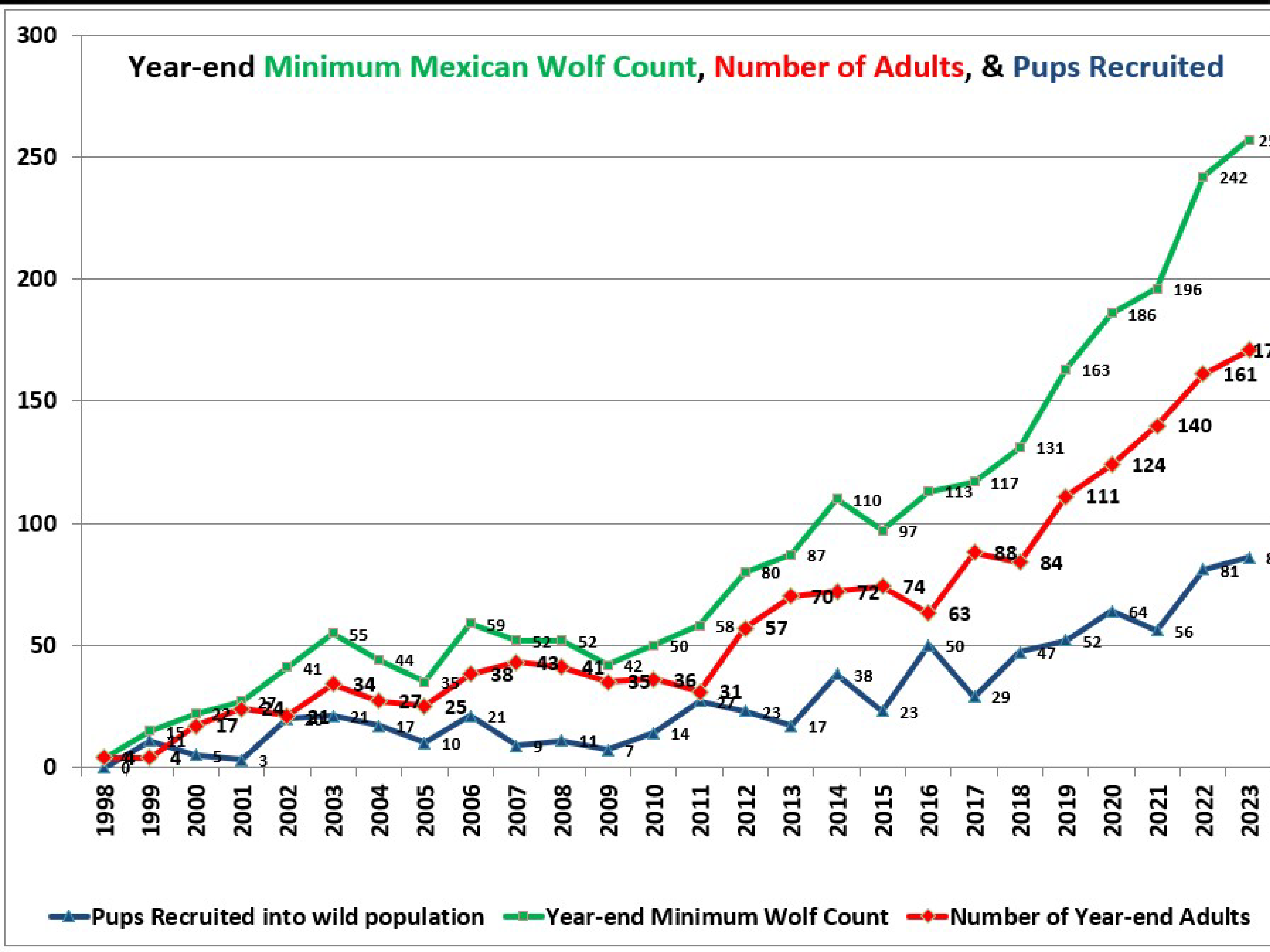
a) Average population abundance is ≥ 320 over 8 consecutive years
b) The genetic diversity available from the captive population has been incorporated into the population so that 22 released wolves have survived to breeding age.

Mexico

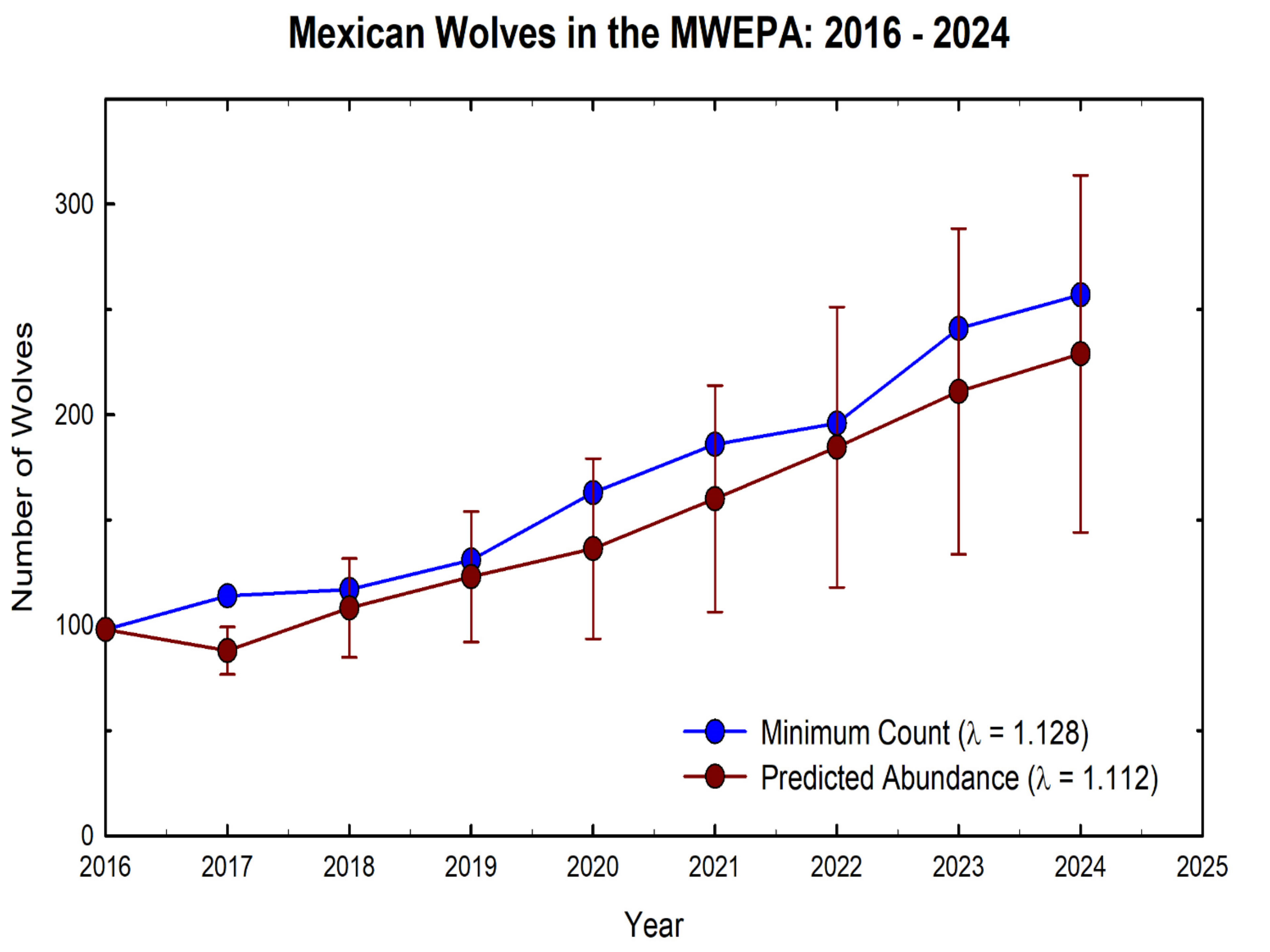
a) Northern Sierra Madre Occidental average population abundance is ≥ 200 over 8 consecutive years
b) The genetic diversity available from the captive population has been incorporated into the population so that 37 released wolves have survived to breeding age.

Wild Population US

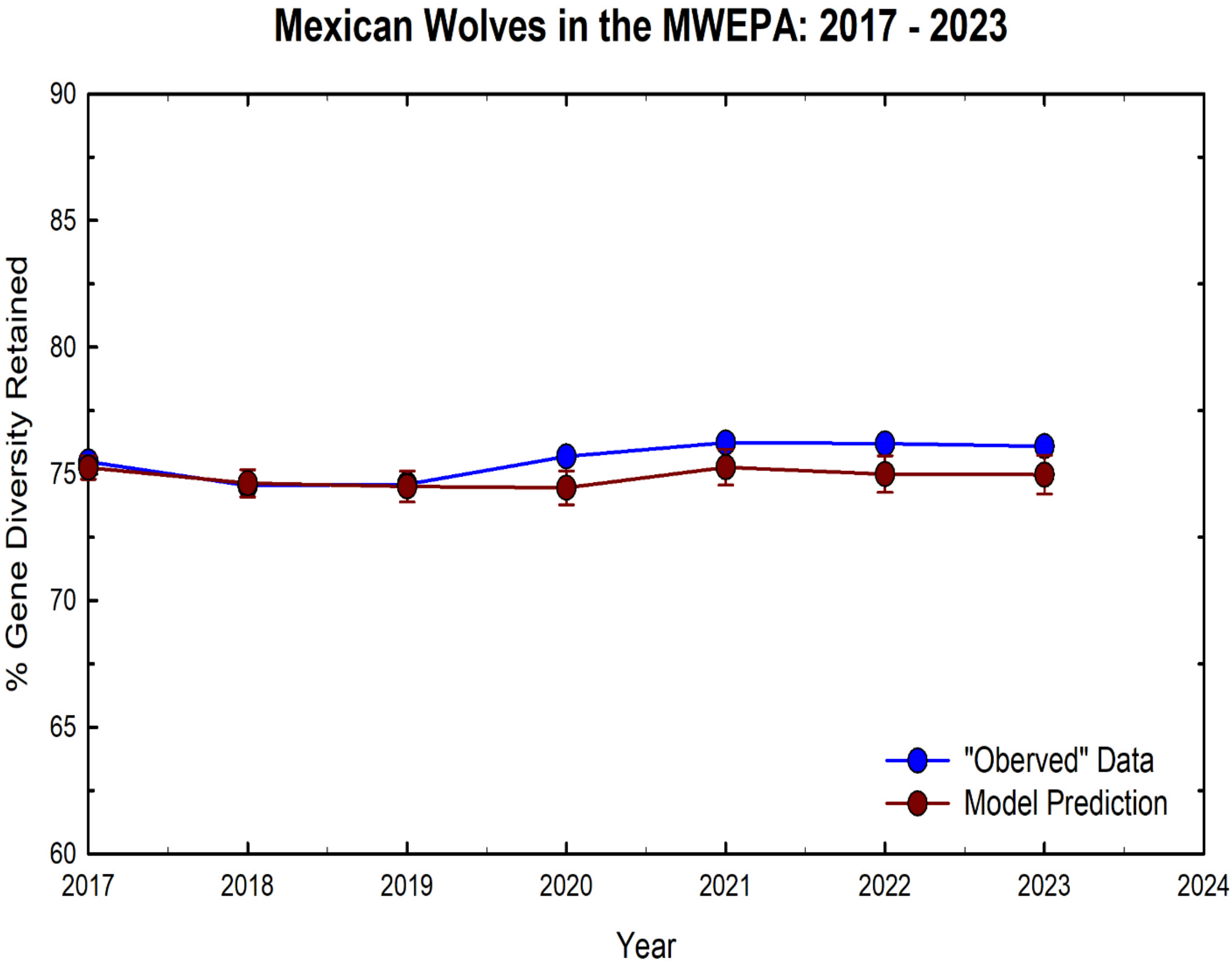
Photo Credit: USFWS



Year-end Minimum Mexican Wolf Count, Number of Adults, & Pups Recruited
Pups Recruited into wild population
Year-end Minimum Wolf Count
Number of Year-end Adults



Mexican Wolves in the MWEPA: 2016 - 2024
Number of Wolves
0
100
200
300
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Year
Minimum Count (λ = 1.128)
Predicted Abundance (λ = 1.112)


Mexican Wolves in the MWEPA: 2017 - 2023
% Gene Diversity Retained
90
85
80
75
70
65
60
2017
2018
2019
2020
2021
2022
2023
2024
Year
"Oberved" Data
Model Prediction

Wild Population MX

Photo Credit: Carlos A Lopez Gonzalez

Recovery in Mexico

Annual releases 2011-2022

17 litters born in the wild

1 pack with 5 consecutive litters in the wild

Discussing second recovery site in Durango

Photos and information: Carlos Lopez

Coexistence

Cooperation with APHIS Wildlife Service

Range Riders

Non-lethal munitions

NEW MEXICO GAME & FISH

ARIZONA GAME & FISH

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

SEMARNAT
SECRETARÍA DE
MEDIO AMBIENTE
Y RECURSOS NATURALES

ESTADOS UNIDOS MEXICANOS

USDA
APHIS

CONANP
Comisión Nacional
de Áreas Naturales
Protegidas

New Mexico Department of Game & Fish

Questions?