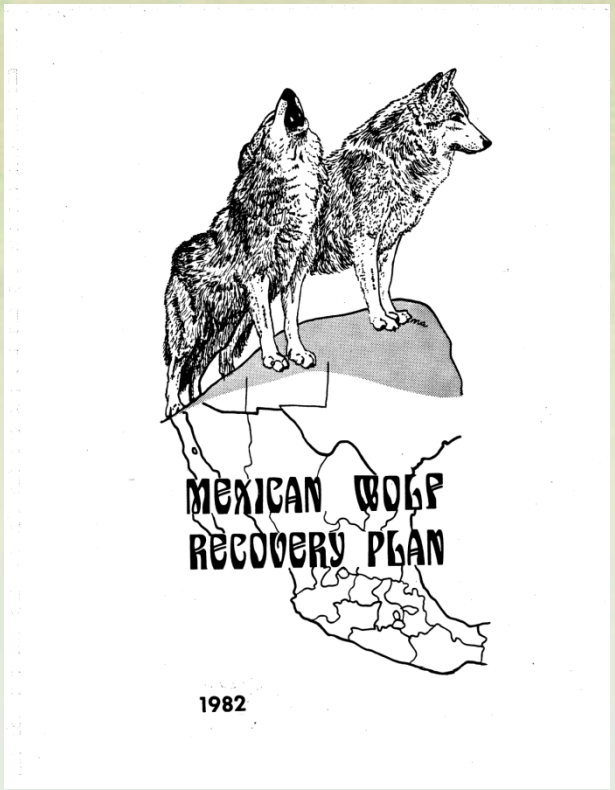
Mexican Gray Wolf

October 25, 2019
New Mexico State Game Commission Meeting
Farmington, NM

Wildlife Management Division

Past, Current, and Future Roles



- Helped Develop 1982 Recovery Plan
- Became a Cooperating Agency as part of 1998 Experimental Population
- 2011 no longer Cooperating Agency
- 2011-Present working with US/MX government's on policy level only

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Past, Current, and Future Roles

- **Become Cooperating Agency again**
- **Have a larger role on policy and on-the-ground management**

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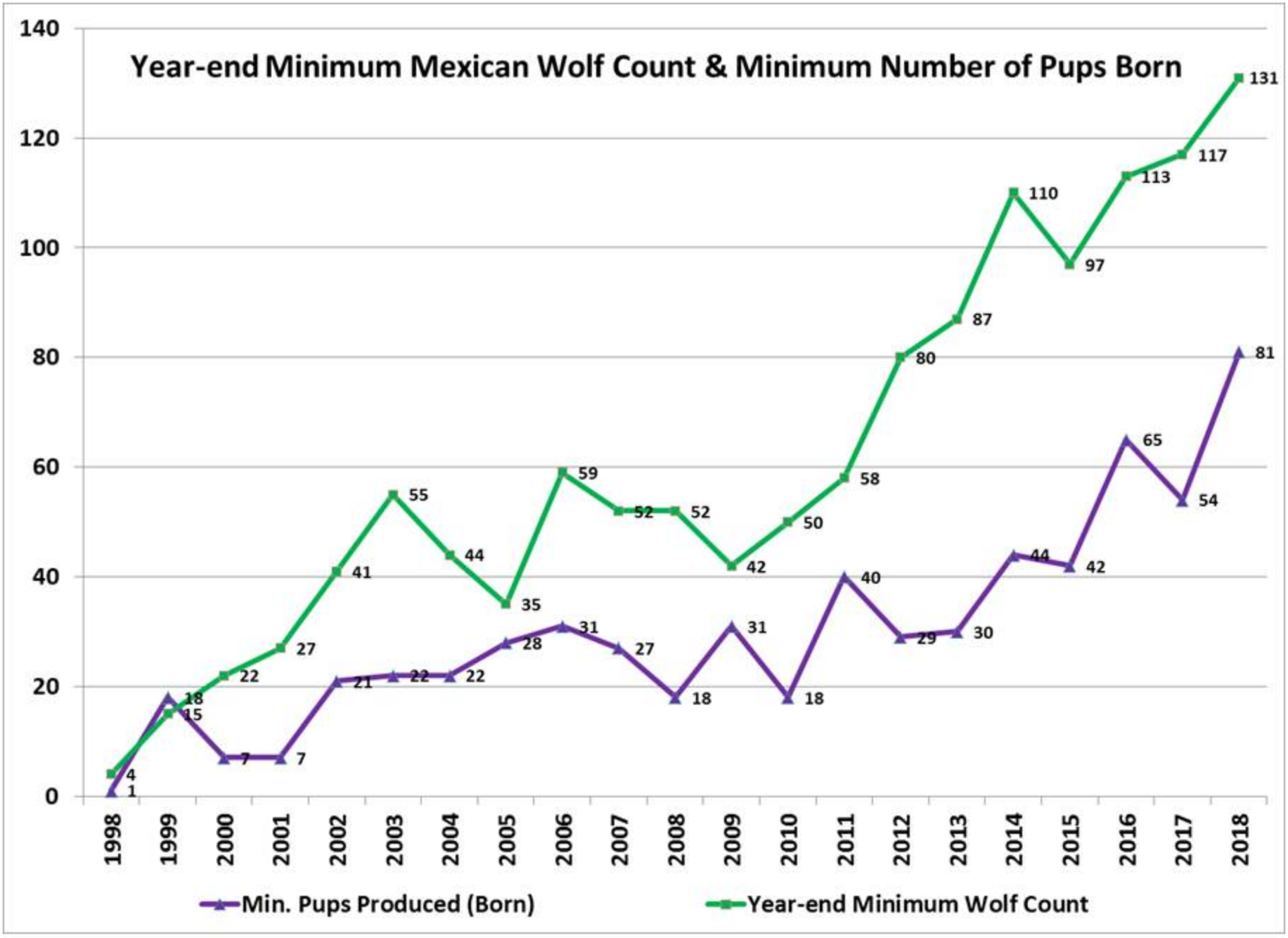
Year-end Minimum Mexican Wolf Count & Minimum Number of Pups Born
140
120
100
80
60
40
20
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
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4
18
22
27
41
55
44
35
59
52
52
42
50
58
80
87
110
97
113
117
131
1
15
7
7
21
22
22
28
31
27
18
31
18
40
29
30
44
42
65
54
81
Min. Pups Produced (Born)
Year-end Minimum Wolf Count

Genetic Recovery Criteria

The genetic diversity available from the captive population has been incorporated into the population so that 22 released wolves have survived to breeding age.

Interim goal of 9 animals surviving to breeding age by 2022.

Cross fosters

- 2 animals counting towards recovery goals
- 3 yearlings being monitored
- 12 pups placed into dens spring 2019
  - 1 collared so far
- Goal for 2020 as many as logistically possible

Cross fosters

- **32 pups born (or conceived) in captivity released into wild dens since 2014**
- **Minimum of 9 pups out of 20 (45%) were recruited into the population**
- **Minimum 4 out of 12 survived to breading age (33%)**
- **3 out of 4 breeding age animals have produced offspring**
  - **Minimum 18 pups produced***
  - **Have started reproducing at age 2**

Recommendations

- **Direct he Department to become a Cooperating Agency and sign the associated MOU**
- **Authorize the Director to allow for the importation and release of pups for cross foster in NM**
- **Authorize the Director to allow for the importation of wolves into captive facilities in NM for management purposes**

Questions

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Questions?

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Habitat Suitability

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Perspective

Perils of recovering the Mexican wolf outside of its historical range

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ARTICLE INFO

Keywords:
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Genetic integrity
Genetic swamping
Historical range
Recovery

ABSTRACT

The Mexican wolf (*Canis lupus baileyi*) was included in the 1973 Endangered Species Act listing of the gray wolf (*C. lupus*), but then listed separately as a subspecies in 2015. Early accounts of its range included the Sierra Madre Occidental of Mexico, southeastern Arizona, southwestern New Mexico, and sometimes western Texas, supported by ecological, biogeographic, and morphological data. There have been multiple unsuccessful attempts to revise the original 1982 recovery plan and identify areas suitable for Mexican wolf reintroduction.

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Population status

- First release 2011 Sonora; 2012 Chihuahua
- First wild born litter produced in 2014
- First natural wild park producing a litter 2017
- Approximately 30 wolves in the wild
- A minimum of two pairs producing pups in 2019

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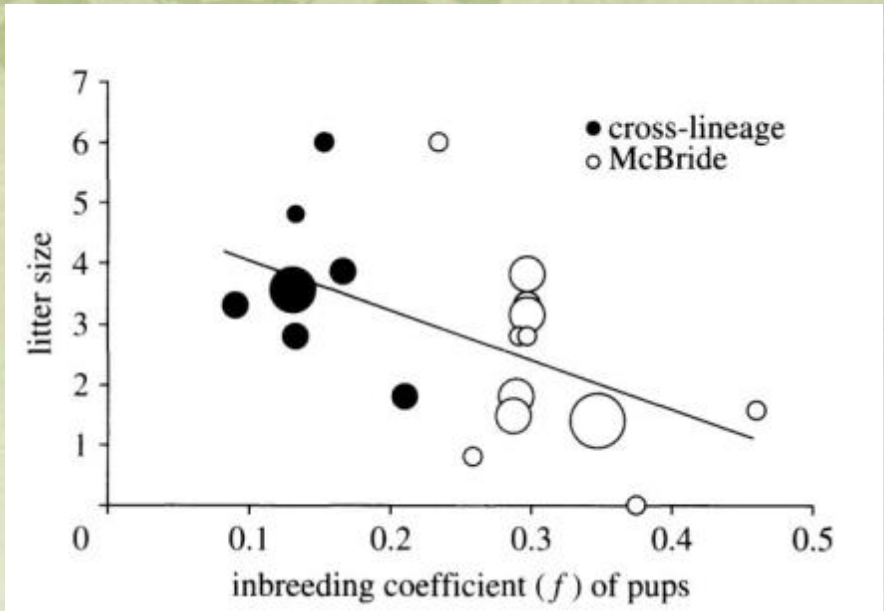
Initial Genetic Diversity Concerns



39 litters (1998-2006)

PROCEEDINGS OF THE ROYAL SOCIETY B

Proc. R. Soc. B (2007) **274**, 2365–2371
doi:10.1098/rspb.2007.0785
Published online 3 July 2007

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.

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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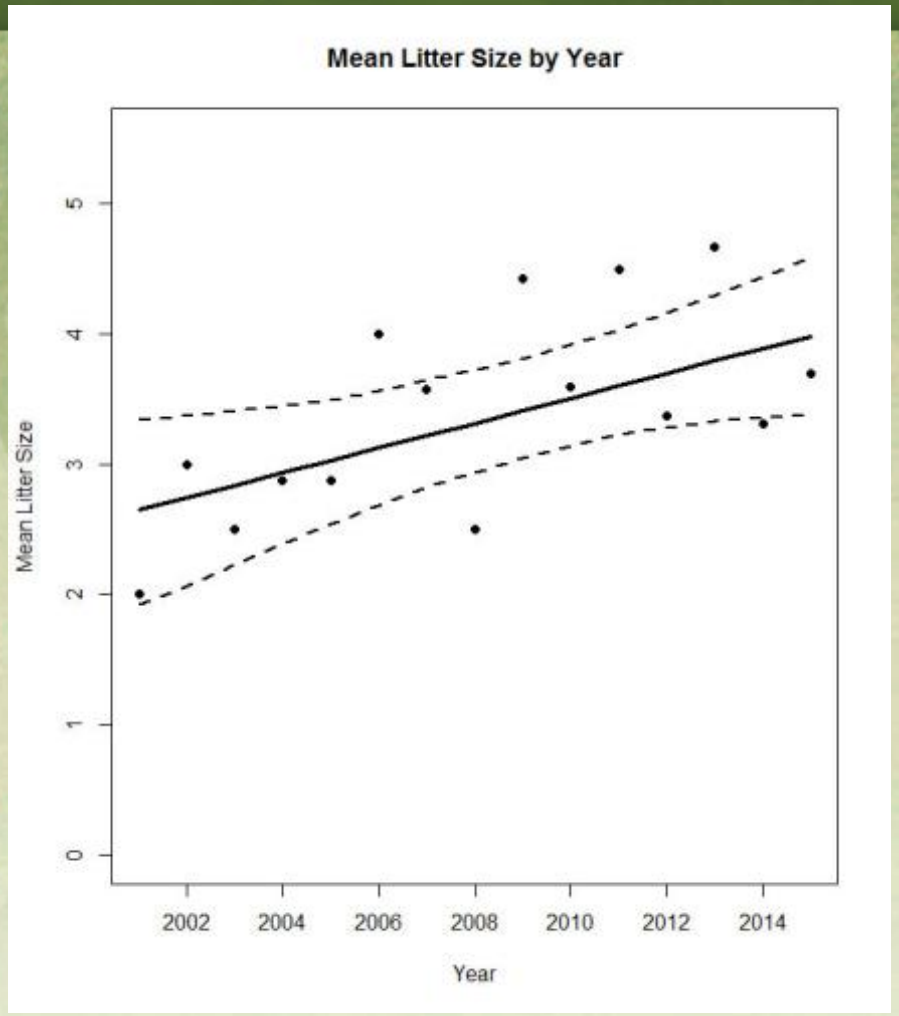
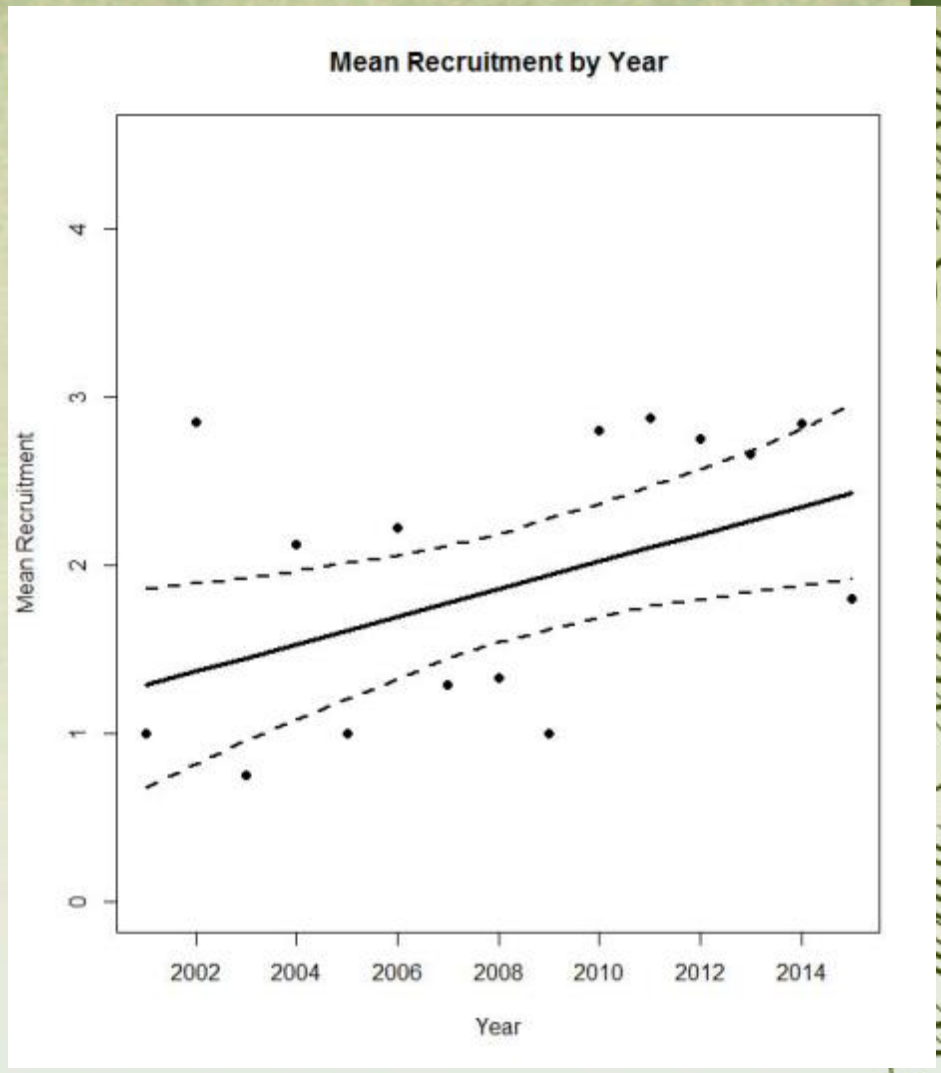
Accepted 13 June 2007

Updated Analysis of Inbreeding Effects

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

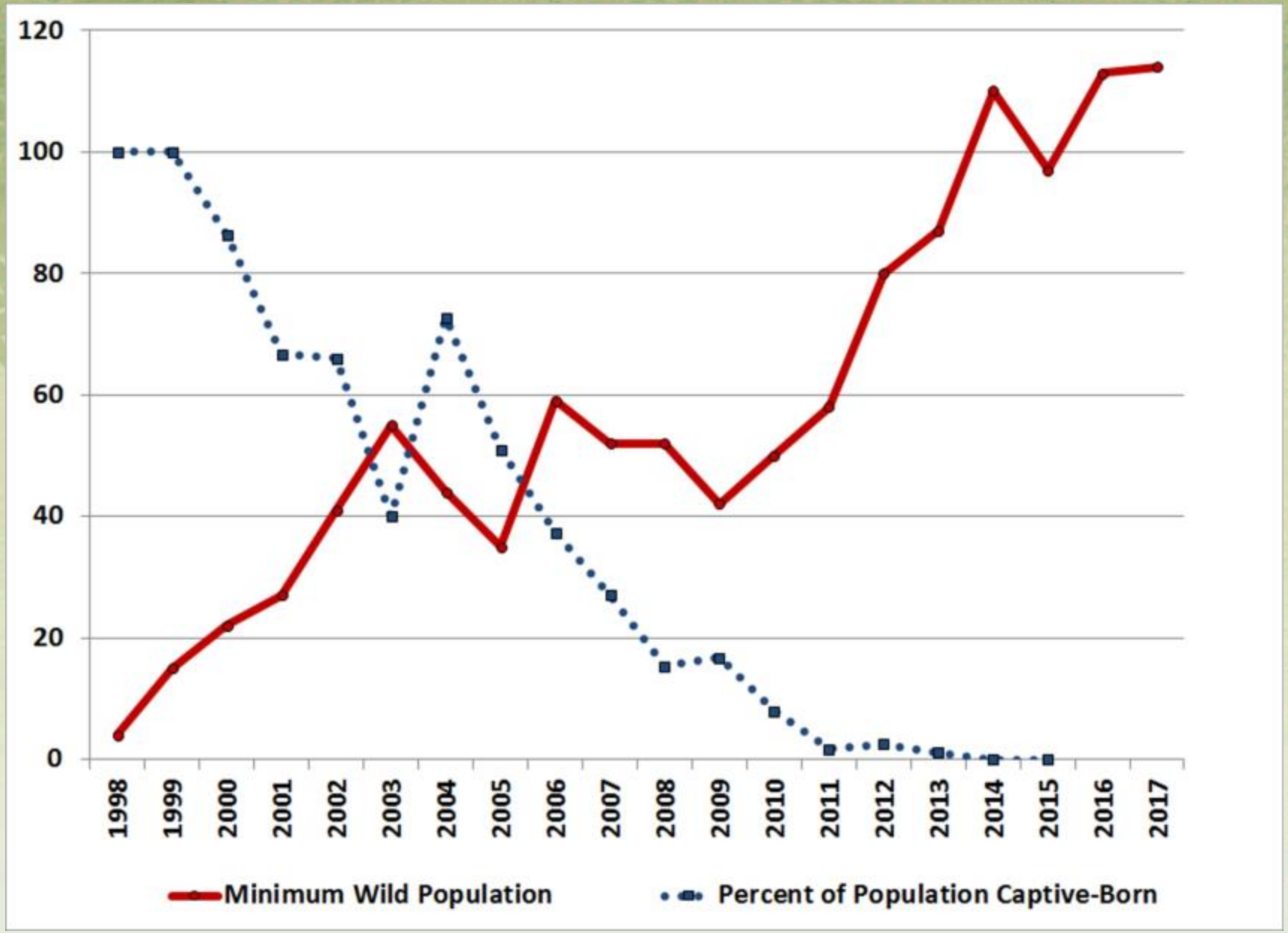

Mean Litter Size by Year
Mean Litter Size
0
1
2
3
4
5
2002
2004
2006
2008
2010
2012
2014
Year


Mean Recruitment by Year
Mean Recruitment
0
1
2
3
4
2002
2004
2006
2008
2010
2012
2014
Year

Fate of Captive-raised Wolves

Individual	Fate
F836	Illegally shot
F1105	Illegally shot near a residence
F1218	Illegally shot
F1106	Lethally removed for nuisance issues
M1130	Lethally removed for nuisance issues
M1133	Removed to captivity for nuisance issues
M1054	Removed to captivity for nuisance issues
M1051	Fate unknown
F1126	Released with M1051 but he split. Female captured with pups, 2 pups cross-fostered into the wild Dark Canyon Pack (both now breeders in other packs). Female now dead.

- The last 9 cases of captive–raised wolves released (2008-2017), 8 failed to produce offspring that lived 1 year. The only successful genetic contribution were pups from a captive-born female that were cross-fostered and raised by a wild pack.


120
100
80
60
40
20
0
1998
1999
2000
2001
2002
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2004
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2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Minimum Wild Population
Percent of Population Captive-Born

Changes from Draft

1. Mexico recovery 170 to 200
2. Language on the regulatory mech. post delisting
3. Clarification on abundance criteria
4. No downlisting if MX pop. meet criteria but not US pop.
5. Release language

Recovery Criteria

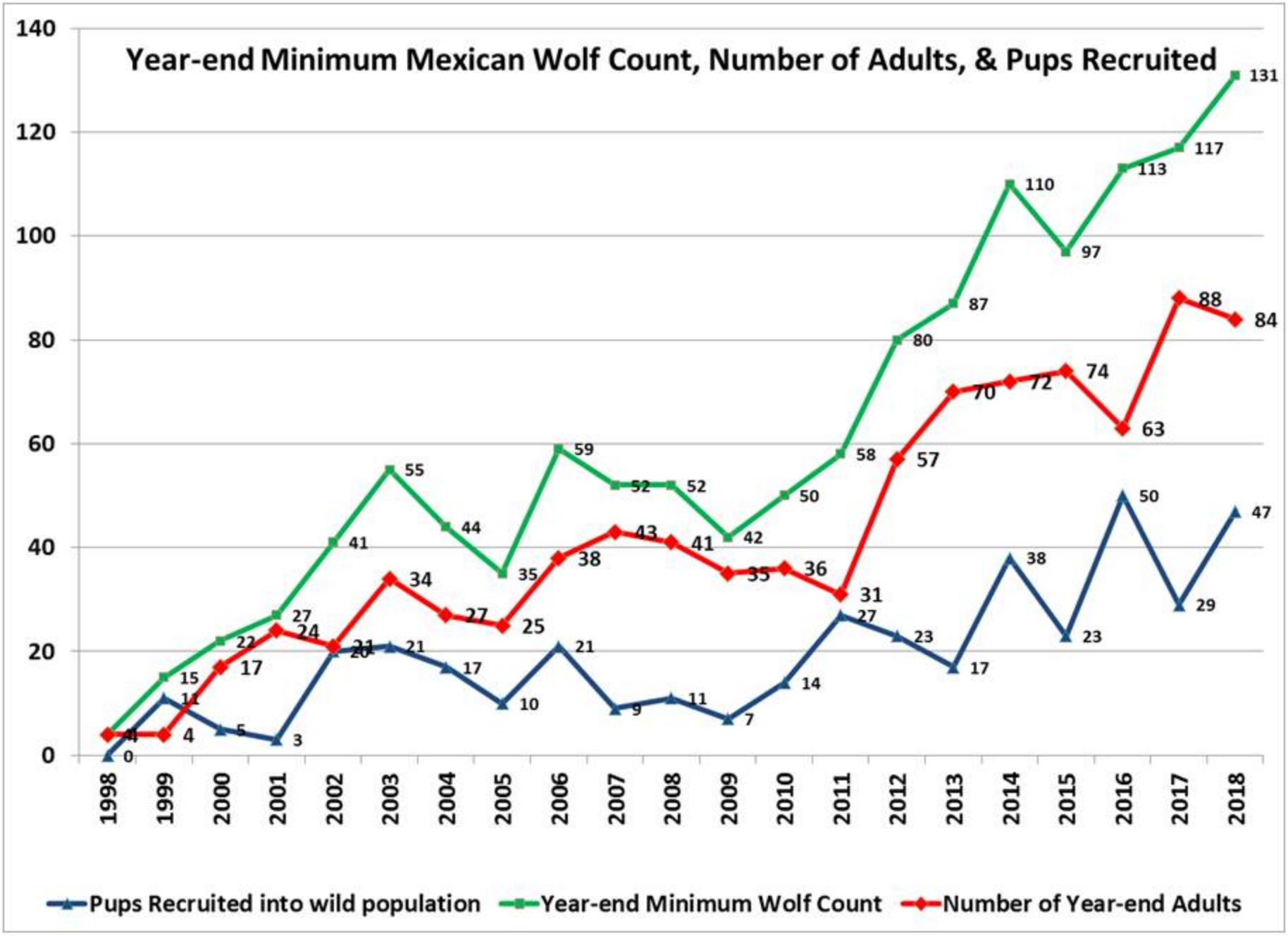
2. Effective state and tribal regulations are in place in the MWEPA in those areas necessary for recovery…Mexico has a proven track record protecting Mexican wolves…

Release Language

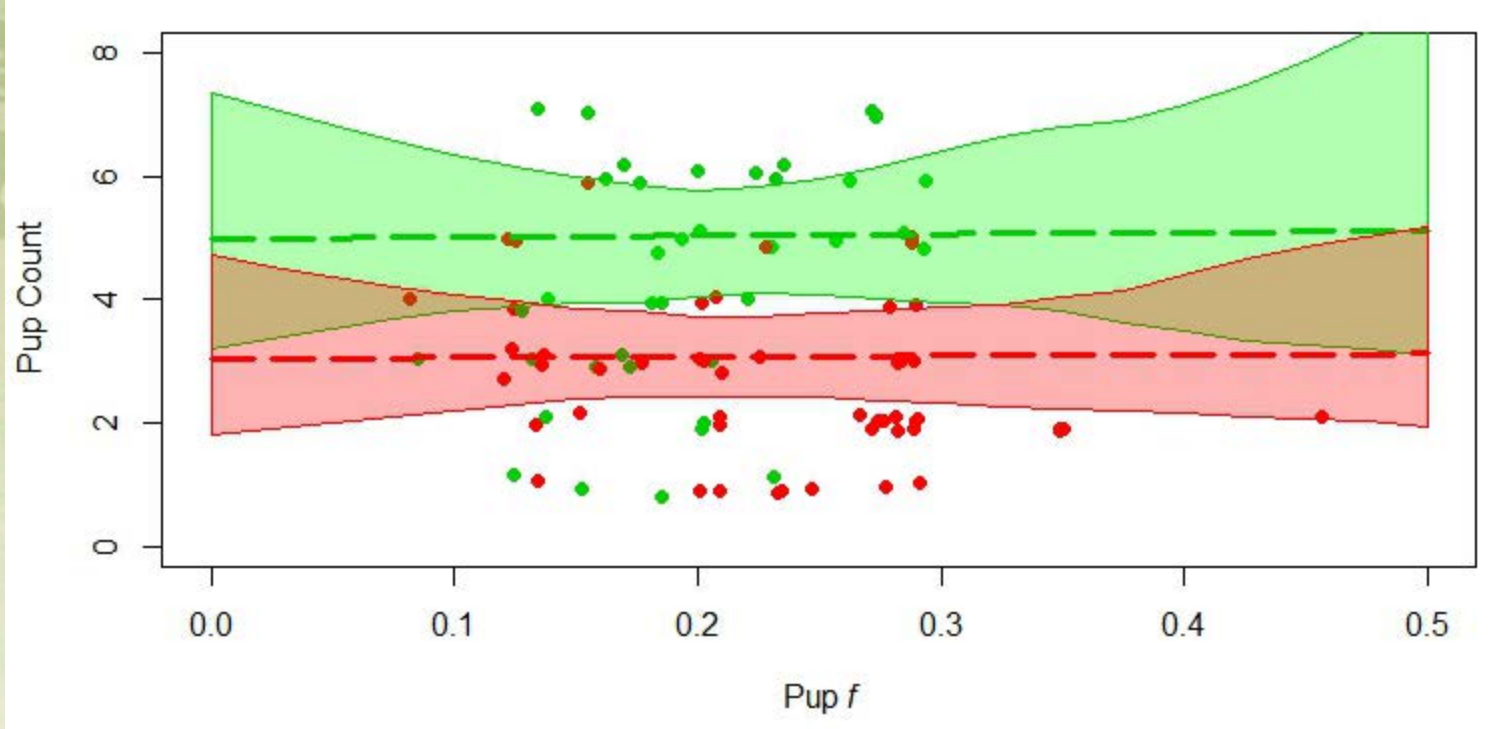
"...will determining the timing, location and circumstances of releases of wolves into the wild ..., from the captive population, with the Service providing collaborative..."

Release Language

"In order to achieve the genetic criteria ... decisions regarding the timing, location and circumstances of Mexican wolf releases will be based on input from the IFT, and will be made cooperatively by the Service with NMDGF 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)"


Year-end Minimum Mexican Wolf Count, Number of Adults, & Pups Recruited
140
120
100
80
60
40
20
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
0
11
5
3
20
21
17
10
21
9
11
7
14
27
23
17
38
23
50
29
47
4
17
24
34
27
25
38
43
41
35
36
31
57
70
72
74
63
88
84
4
15
22
27
41
55
44
35
59
52
52
42
50
58
80
87
110
97
113
117
131
Pups Recruited into wild population
Year-end Minimum Wolf Count
Number of Year-end Adults

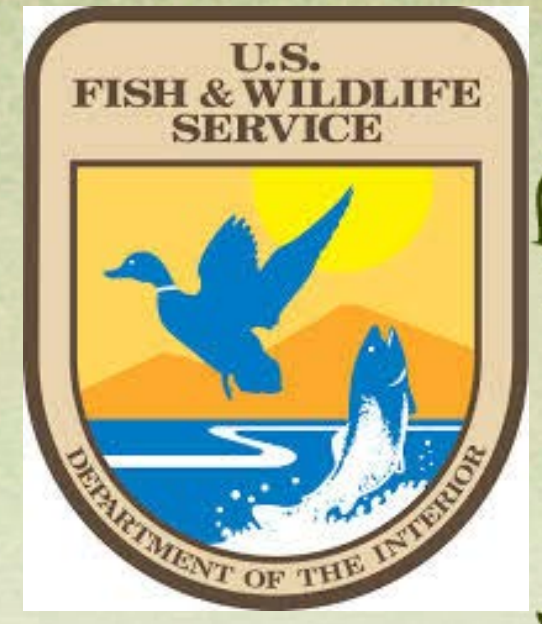
Biological Info



Clement and Cline 2016

Plan Requirements

- **Objective and Measurable criteria**
- **Site – specific management actions**
- **Estimates of time and cost**



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PROTEGIDAS

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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

Captive Breeding

- Created with the last remaining wild wolves
- 51 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

Wild Population US

Photo Credit: USFWS

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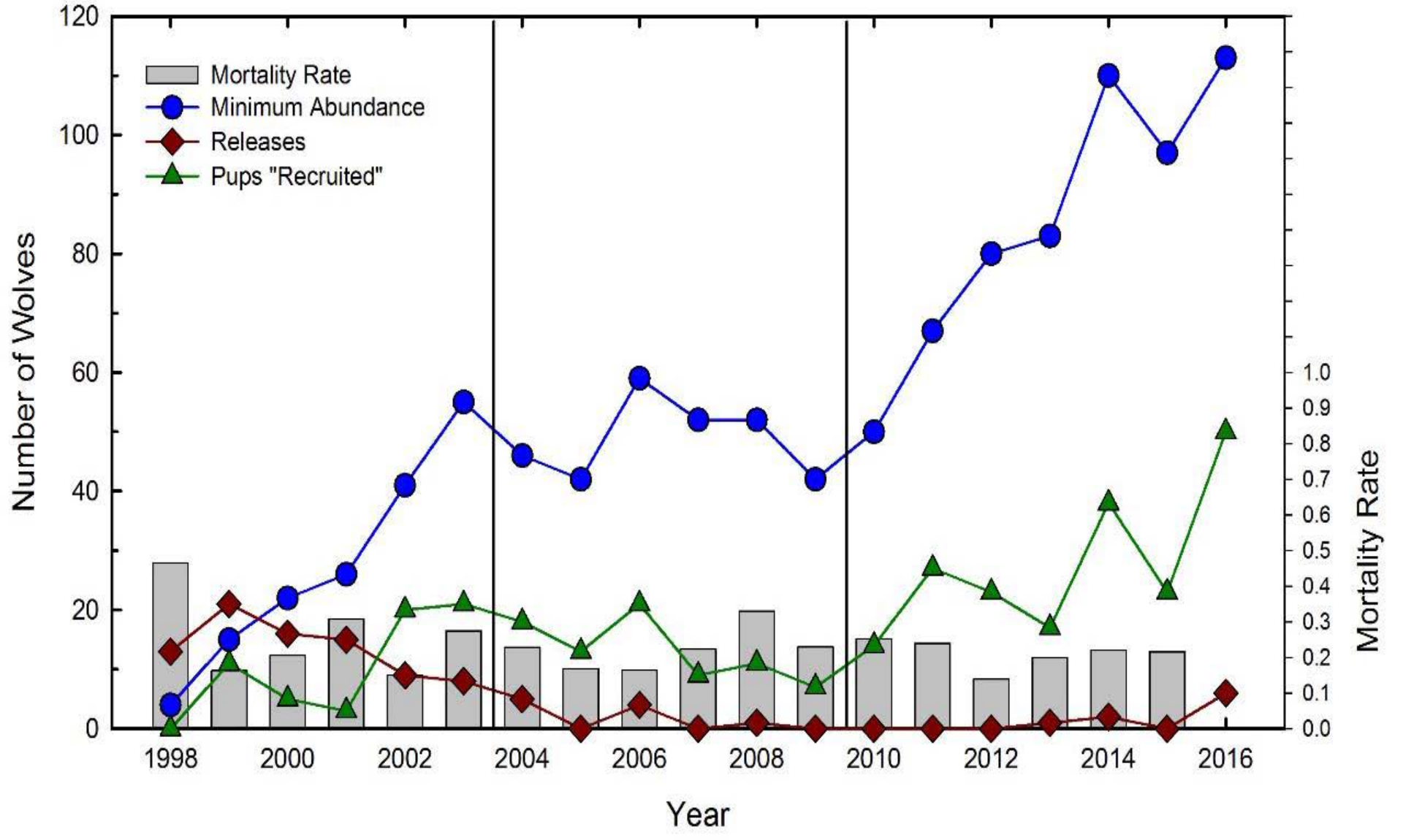
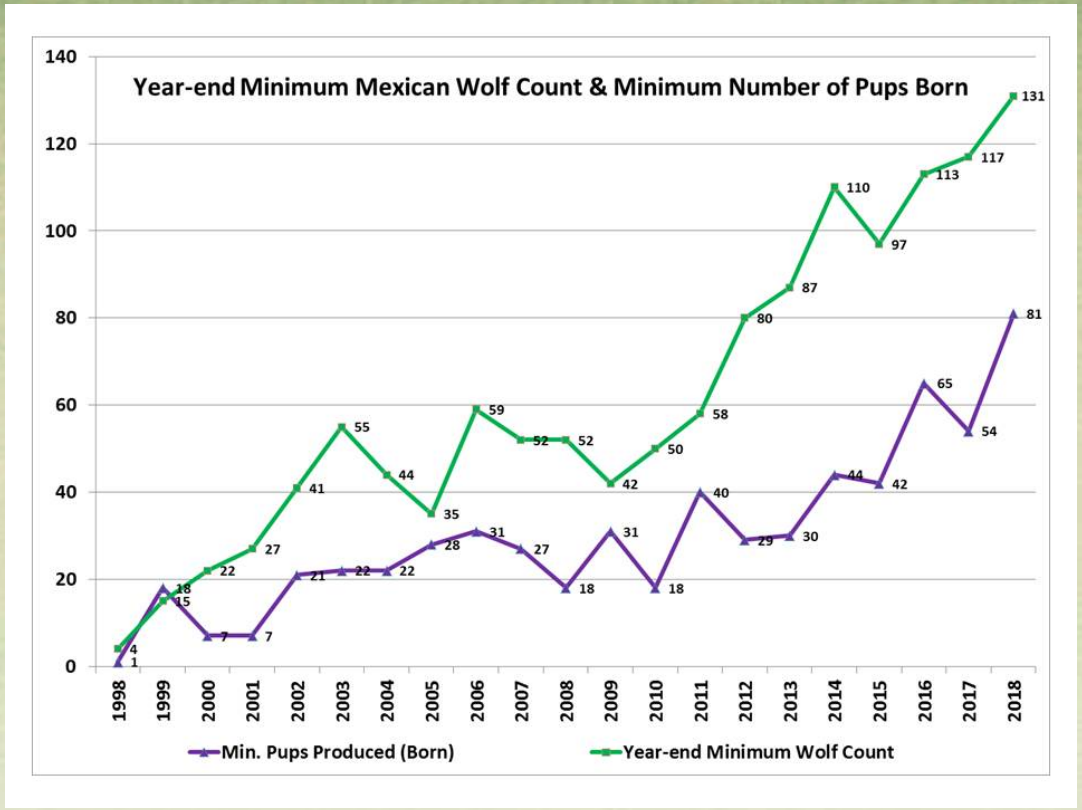
PHASE I
Mean λ = 1.689
Mean releases: 13.5
Pups "recruited": 10.0
Annual mortality: 0.241
Mean removals: 8.3

PHASE II
Mean λ = 0.956
Mean releases: 1.7
Pups "recruited": 13.2
Annual mortality: 0.218
Mean removals: 11.8

PHASE III
Mean λ = 1.148
Mean releases: 1.3
Pups "recruited": 27.4
Annual mortality: 0.211
Mean removals: 3.8



Initial Releases



1998	13		2004	5		2010	0
1999	21		2005	0		2011	0
2000	16		2006	4		2012	0
2001	15		2007	0		2013	1
2002	9		2008	1		2014	2
2003	8		2009	0		2015	1
						2016	6
						2017	4
						2018	8
						2019	12

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Management Hurdles

- **Livestock Depredation**
- **Release of naive adult wolves**
- **Movement of animals across international border**
- **Permitting issues**

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 MX

Photo Credit: Carlos A Lopez Gonzalez

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Recovery in Mexico

- Approximately 30 alive in the wild in Mexico
- Annual releases 2011-2018
- ~45 wolves released since 2011.
- Minimum of 19 pups documented
- One pack with 4 consecutive litters in the wild

Photos and information: Carlos Lopez

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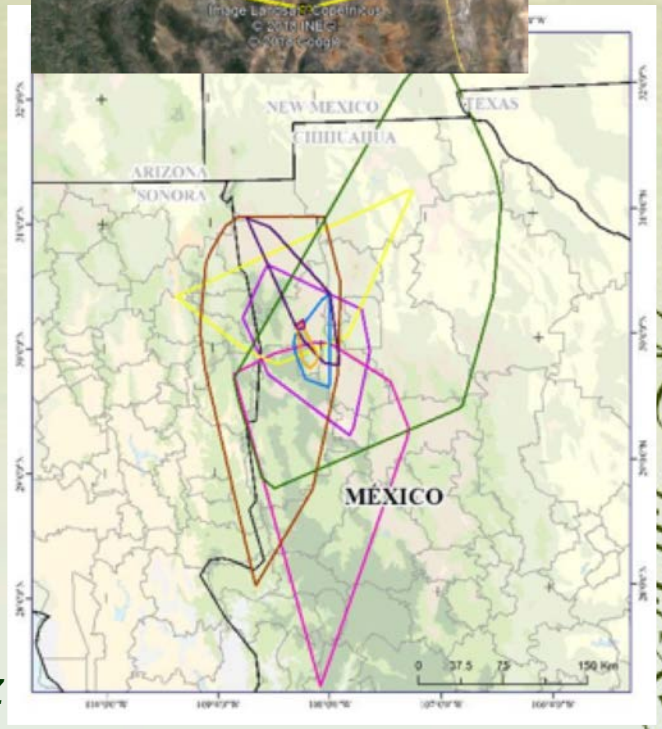
Recovery in Mexico

- At least 2 collared wolves have entered the US.
- Two uncollared wolves documented near border (outside Ciudad Juarez).
- Juveniles dispersing and forming new packs.
- Recovery in Mexico tracking similarly to the early years in AZ/NM
- Wild born animals survival much higher.
- Mexico has more releases planned



Photos and information: Carlos Lopez

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Recovery Plans

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

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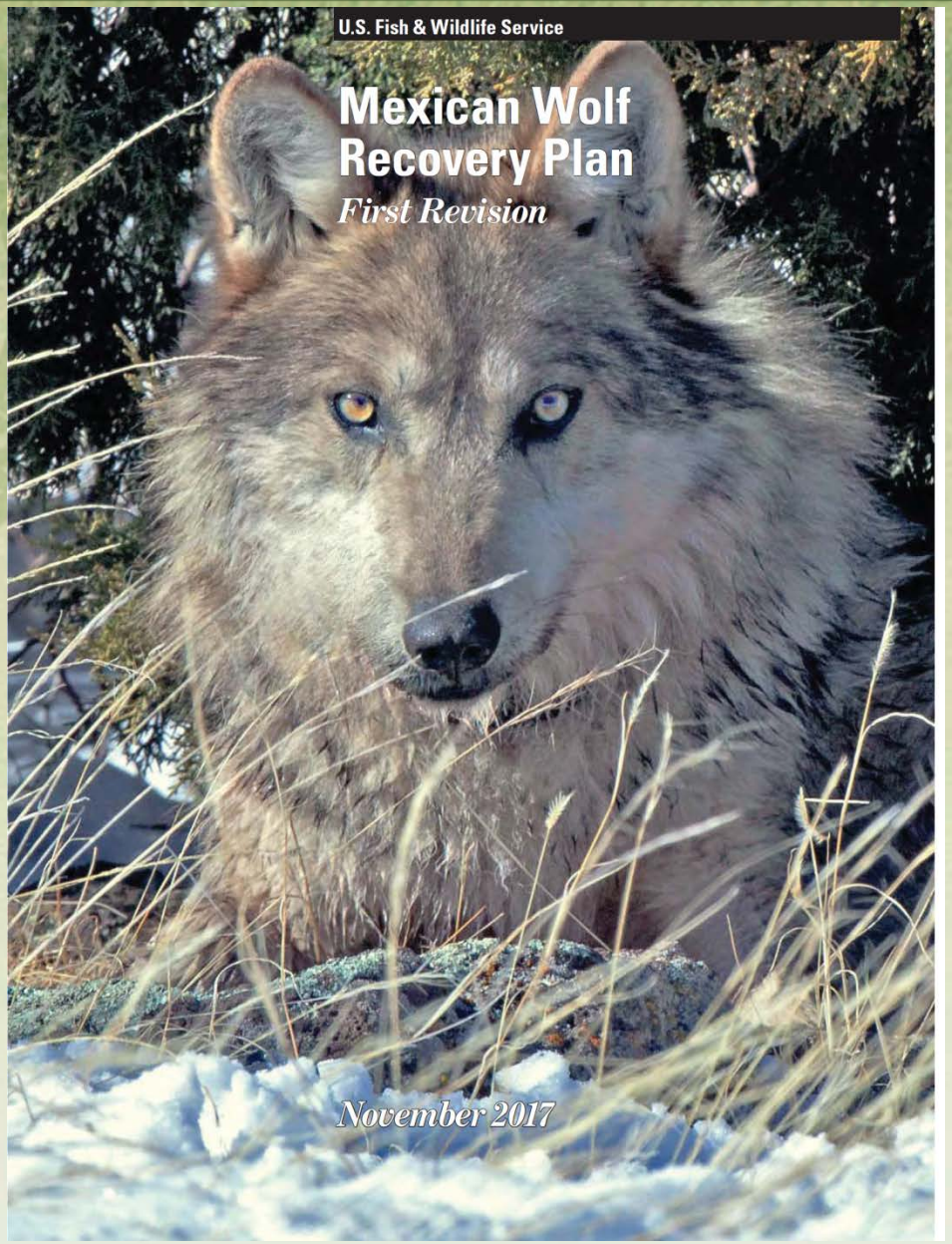
Previous Attempts to Update

- 1995
- 2003
- 2010



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Plan Revision

- Recovery Workshops held December 2015, March 2016, April 2016, August 2016, November 2016, and February 2017

- Final plan released Nov. 28, 2017

http://www.wikiwand.com/es/Sierra_Madre_Occidental

Habitat Suitability

Mexican wolf habitat suitability analysis in historical range in the Southwestern US and Mexico

Final Report

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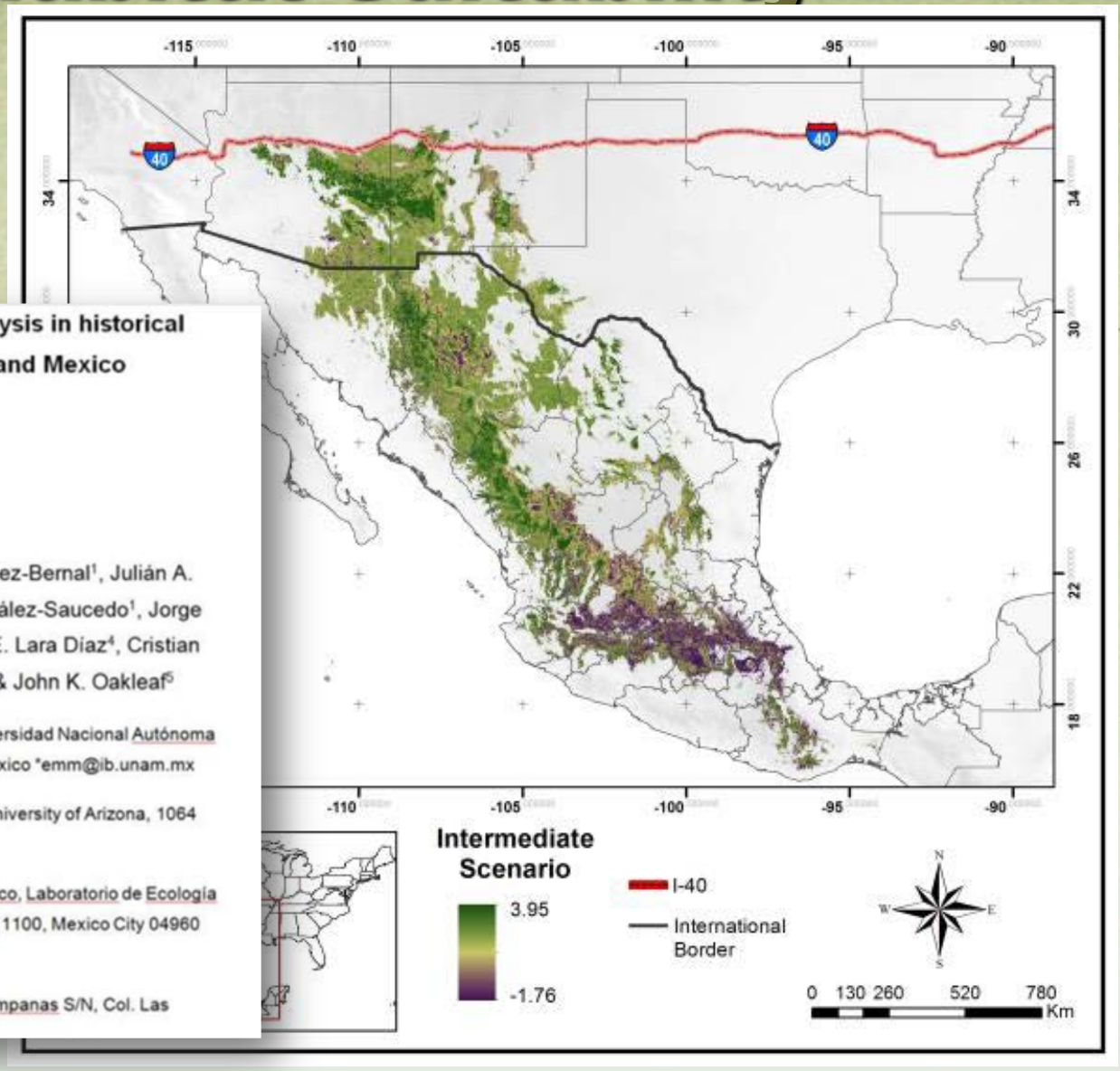

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Biological Info

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

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