MEXICAN WOLF

Canis lupus baileyi

POPULATION VIABILITY ASSESSMENT

REVIEW DRAFT REPORT OF WORKSHOP

Prepared by:
Ulysses S. Seal and Workshop Participants

Sponsored and Organized by:

Fossil Rim Wildlife Center

IUCN/SSC/CBSG

22 - 24 October 1990

Fossil Rim Wildlife Center, Texas

List of Donors

TABLE OF CONTENTS

MEXICAN WOLF

Canis lupus baileyi

Population Viability Assessment

SECTION 1

EXECUTIVE SUMMARY AND RECOMMENDATIONS

Executive Summary

The Mexican wolf is extinct in its former range in the south west of the United States. A small population of uncertain size, but perhaps less than 50, is thought to survive in Mexico. Lack of protected habitat, with a suitable prey base for the wolf, available for the re-establishment of the wolf in the SW USA will likely limit the population size that can be supported in individual areas. Populations separated by barriers that reduce or eliminate the opportunity for recolonization or occasional gene flow will each be subject to population fluctuations and at risk of extinction from local environmental hazards. Small populations are also subject to the potential risks of inbreeding depression.

Since no information was available for the wild population in Mexico, we have used information from other wild populations of the wolf in Italy and the USA, from the small captive Mexican wolf population, and from other captive *Canis lupus* populations as sources of information for modelling small wolf populations. Data from translocation programs of wild caught wolves are not directly applicable to the program for the Mexican wolf (1) given the demonstrable differences in behavior evident between captive bred wolves and their first generation offspring in the red wolf program and (2) the lack of intensive follow up and management of the translocated wild wolves.

Wildlife scientists, conservation organizations, and wildlife authorities have developed a collaborative program for the Recovery of the Mexican wolf under the coordination of the USFWS. The ultimate goal of the program is to restore and maintain a genetically viable, self-sustaining, free-living wolf population. In order to achieve the goal of recovery, it is necessary to understand the risk factors that have affected the survival of the wolf and that may affect a reintroduction program. Risk evaluation is a major concern in endangered species management and a goal is to reduce the risk of extinction to an acceptable level. A set of software tools to assist simulation and quantitative evaluation of risk of extinction is available and was used as part of Population Viability Assessment Workshop. This technique can improve identification and ranking of risks and can assist assessment of management options. Of importance to the success of these recovery efforts will be participation by institutions and individuals with extensive experience with maintaining and propagating wolves in controlled environments, including managers, husbandry experts, and veterinarians.

Twenty-eight biologists, managers, and decision makers attended a Population Viability Assessment (PVA) Workshop at the Fossil Rim Wildlife Center, Glen Rose, Texas on 22-24 October, 1990 to apply these recently developed procedures to the captive and wild populations and the reintroduction of the Mexican wolf. The Captive Breeding Specialist Group, the Canid and Wolf Specialist Groups of the IUCN/Species Survival Commission were asked to collaborate in this PVA workshop to assist the recovery effort. The purpose was to review data from the wild population as a basis for developing stochastic population simulation models. These models estimate risk of extinction and rates of genetic loss from the interactions of demographic, genetic, and environmental factors as a tool for ongoing management of the subspecies. Other goals included determination of habitat requirements, population sizes, role of direct threats including killing by people as a factor in the decline of the species, potential role of indirect threats such as disease, and prioritized research needs.

The first morning and afternoon consisted of a series of presentations summarizing data on the wild and captive populations, canid genetics, disease, public education programs, and reintroduction work with the red wolf. A brief presentation on population biology, the PVA process, and the use of VORTEX was made as an introduction to the use of the models and the problems associated with small isolated populations. The participants formed four working groups (wild population, captive populations, genetics, and modelling) and later three additional groups (reintroduction, research, and public education) to review in detail current information, to develop values for use in the simulation models, and to develop management scenarios and recommendations. Stochastic population simulation models were initialized with ranges of values for the key variables to estimate the viability of the wild population using the VORTEX software modelling package.

In the models, 50% of adult males were assumed to be available for breeding. The age of maturity for females and males was set at 3 years. The interbirth interval was 2 years (50% of females produce a surviving litter with a mean of 5 pups each year). The risk of disease events as stochastic events were included in some of the models. The initial population was set at either 25, 50, 100, and 150 (reflecting the range of estimates of the possible habitat carrying capacity). All scenarios were initialized with an equal sex ratio and stable age distribution. Reproduction was held constant. Effects of inbreeding depression were included in some scenarios. Variables initialized with a range of values included mean adult mortality (either 10 or 13%), and catastrophes to determine what combination of conditions would produce a viable population in terms of probability of extinction in relation to the intrinsic rate of increase. Projections were done for 100 years with summary reports at 10-year intervals. Each scenario was run 1000 times.

This workshop report includes a set of recommendations for reduction of human caused mortality, research and management of the wild populations as well as sections on the history of the population, and the population biology and simulation modelling of the population.

Recovery of the Mexican Wolf

Recovery of the Mexican Wolf is dependent upon:

1. Protection of any existing populations in the wild and augmentation where necessary to its full carrying capacity.

2. Rapid expansion for the captive genetic pool to be used to augment the current wild populations and establish new populations as necessary.
3. Establish new wild populations through out the historic range.

Identification of sites to the reach these goals:

It is recognized that it may not possible to achieve these goals with a single continuous pop it may be necessary to establish sub pops which will require active management as a metapopulation.

The historic range of the Mexican wolf extended from Zacatecas into the southern US. this international distribution of the Mexican wolf will require cooperative and collaborative programs between Mexico and the US.

The Endangered species Act of the U.S. charges the USFWS with recovery endangered species by implementing recovery plans to the maximum extent practical. In Mexico the Direccion General de proteccion Ecologica de los Recursos Naturales has the responsibility to ensure the survival of the Mexican wolf.

The Mexican wolf recovery plan was approved in 1982, and has a recovery goal of one hundred individuals in the wild.

The status of the wild population is unknown at this time, although it is estimated to be less then 50 individual animals, all of which are in Mexico.

The U.S. population has not been legally classified as extinct, but no animals are known to exist in the U.S. in the wild. The last confirmed Mexican wolf taken in the U.S. was in 1970. There have been numerous reports of Mexican wolves in the U.S., but none of these have been confirmed.

The Mexican wolf is legally protected in Mexico, but this protection is not enforced. It is believed that the Mexican wolf still ranges in isolated areas of Mexico, but as mentioned above, the numbers are unknown. There are many reported sightings in Mexico, but very few of these have been confirmed.

There is ample habitat to support wild populations of Mexican wolves both in Mexico and the United States. The recovery of a viable population is highly dependent a vigorous enforcement of protective regulations.

Captive breeding programs for the Mexican wolf exist in both Mexico and the U.S. Presently the captive population consist of 40 certified individual. In order to recover the Mexican wolf, rapid expansion of the captive breeding program is essential as outlined in the captive population section of this document.

Recommendations:

1. It is estimated that in order to biologically recover the Mexican wolf, a meta-population of at least 1000 wolves will need to be free-ranging in the wild.

2. Because of the change in biology and the taxonomic status the 1982 Mexican Wolf Recovery Plan should be revised.

3. A Species Survival Masterplan should be drafted for the Mexican wolf and incorporated into the above mentioned recovery plan. This type of combined document has worked well for the Red Wolf, and the Black Footed Ferret.

4. The selection of individual Mexican wolves for reintroduction must not jeopardize the genetic or demographic integrity of the captive population. At this time it is not known what this means in actual numbers, but meeting this condition may require a captive population in excess of 70 animals prior to the initial reintroduction. A continuing reintroduction program will require significantly more animals in the captive population with the current target level being at least 500 animals in captivity as outlined the captive breeding section of this document.

5. A collaborative effort needs to be established between Mexico and the United States in order to manage the Mexican wolf as a "single population." This cooperative management plan needs to take into consideration the distribution and numbers of each population; genetic and demographic stability; and the security of the population.

MEXICAN WOLF

Canis lupus baileyi

Population Viability Assessment

SECTION 2

POPULATION BIOLOGY AND SIMULATION MODELLING

Population Biology

The Mexican wolf is extinct in its former range in the south west of the United States. A small population of uncertain size, but perhaps less than 50, is thought to survive in Mexico. Lack of protected habitat, with a suitable prey base for the wolf, available for the re-establishment of the wolf in the SW USA will likely limit the population size that can be supported in individual areas. Populations separated by barriers that reduce or eliminate the opportunity for recolonization or occasional gene flow will each be subject to population fluctuations and at risk of extinction from local environmental hazards. Small populations are also subject to the potential risks of inbreeding depression.

Since no information was available for the wild population in Mexico, we have used information from other wild populations of the wolf in Italy and the USA, from the small captive Mexican wolf population, and from other captive *Canis lupus* populations as sources of information for modelling small wolf populations. Data from translocation programs of wild caught wolves are not directly applicable to the program for the Mexican wolf (1) given the demonstrable differences in behavior evident between captive bred wolves and their first generation offspring in the red wolf program and (2) the lack of intensive follow up and management of the translocated wild wolves.

Application of these models to a release or reintroduction program would benefit from modelling and analysis of the results from the ongoing red wolf reintroduction program. An appreciation of the high frequency of random adverse events (stochasticity) and their impact on the perceptions of the success or failure of a program is essential to formulate expectations of probable outcomes. It is also useful to appreciate how many ideas fail even with the best possible advice. The importance of a continuing objective reporting process describing events and distributed to all interested parties cannot be over emphasized.

Small and isolated wolf populations are at risk of extinction from the interaction of random and deterministic processes (e.g., skewed sex ratio, failure to locate mates, disease, genetic drift, inbreeding depression, fighting, reduction in populations of prey animals, and poaching). These populations will require intensive management if the Mexican wolf is to survive in the re-established populations for even 50 or 100 years.

The need for and effects of intensive management strategies can be modelled to suggest which practices may be the most effective in preserving the individual wolf populations. A simulation modeling package, VORTEX written by Robert Lacy and Kim Hughes was used as a tool to study the interaction of multiple variables treated stochastically to gain assist a better understanding of the effects of different management manipulations.

The VORTEX program is a Monte Carlo simulation of the effects of deterministic forces as well as demographic, environmental, and genetic stochastic events on wildlife populations. VORTEX models population dynamics as discrete, sequential events (e.g., births, deaths, catastrophes, etc.) that occur according to defined probabilities. The probabilities of events are modeled as constants or as random variables that follow specified distributions. VORTEX simulates a population by stepping through the series of events that describe the typical life cycle of sexually reproducing, diploid organisms.

VORTEX is not intended to give absolute answers, since it is projecting stochastically the interactions of the many parameters which enter into the model and because of the random processes involved in nature. Interpretation of the output depends upon your knowledge of the biology of the wolf, the conditions affecting each of the individual populations, and possible changes in the future. The output is limited by the input. Where needed input data are questionable or questionable, data from other wolf populations or best guesses by wolf experts were provided as input. The results from the simulations can be used to suggest the most critically needed data to provide more reliable results and thus assist the design of needed research for management of the populations.

Starting Population:

Carrying Capacity: K defines an upper limit for the population size, above which additional mortality is imposed in order to return the population to K. In other words, VORTEX uses K to impose a ceiling model of density-dependence on survival rates.

Habitat size and prey availability (density) are indicators of carrying capacity of the respective Parks and surrounding areas. Estimates of possible and probable wolf carrying capacity in the respective protected areas fell between 25 and 150 animals. There are areas with resources for fewer than 25 wolves but it is unlikely that any of the protected areas will sustain more than 150 animals. Therefore, 4 carrying capacities of 25, 50, 100, and 150 wolves to encompass this range were included in the sets of scenarios simulated.

We did not include any trends in carrying capacity over time since the range was encompassed by the K values used. We also did not include any annual variation in K since this tends to have minimal effects on large carnivore populations (as opposed to sustained changes).

Age First Reproduction: VORTEX defines breeding as the time when young are born, not the age of sexual maturity. VORTEX also assumes discrete intervals of years in the case of wolves. For wolves on average the age of first reproduction for females and males in wild populations appears to be 3 years although younger animals in captivity can breed and reproduction may be delayed in wild populations. These values were used in all of the simulation scenarios.

Litter Size: Environmental variation in reproduction is modelled by the user entering a standard deviation (SD) for the percent females producing litters. VORTEX then determines the percent breeding each year of the simulation by sampling from a binomial distribution with the specified mean (e.g., 50%) and SD (e.g., 12.5%). Thus about 66% of the time, the percent of females breeding will fall within ± 1 SD of the mean; about 95% of the time it will fall within ± 2 SD of the mean. The relative proportions of litters of each size (1, 2, 3, etc.) are kept constant; what is varied from year to year is the percent breeding (litter size > 0) and the percent not breeding (litter size = 0).

The maximum litter size observed in the wild for wolves is 9 cubs. Information on wild wolf litter sizes is based upon observation of cubs 3-6 weeks or older and thus does not represent birth litter sizes. Data on captive Mexican wolf litters from the studbook suggest mean litter sizes of 5 ± at birth ( ). There are no field observations on Mexican wolves. The distribution of litter sizes was set in the models as follows:

%	Litter Size
50	0
2.0	1
4.0	2
6.0	3
8.0	4
14.0	5
6.0	6
4.0	7
4.0	8
2.0	9

The proportion of females breeding each year determines the mean interbirth interval. This interval is reported to be 2 years in wild wolves so that 50% of adult females, on average do not produce litters each year. A modest amount of annual variation was included using a standard deviation of 12%.

Sex ratio at birth is taken as equal or 0.500

Males Breeding: Wolves are monogamous in a given season and can breed with the same mate for several years. However, the breeding system modeled by VORTEX assumes that mates are randomly reshuffled each year and that all animals that can breed have an equal probability of breeding. Some animals may be excluded from the breeding pool in a given year if needed.

Two conditions for male wolves were modelled. One for most scenarios, allowed only 50% of the adult males to be in the breeding pool. Because of concerns that for small populations this might be limiting the numbers of adult females breeding and thus increase the probability of extinction, if the adult male population became very small, we also did a set of simulations for K=25 with all adult males in the breeding pool (compare files A18-A25, A54-A57 with files without the 'A' prefix in Table 1). This set of simulations also allowed estimation of the impact of this restriction on males breeding on the rate of loss of genetic heterozygosity in the small population.

Age of Senescence: VORTEX assumes that animals can breed (at the species typical rates) throughout their adult lifespans. The maximum life expectancy is not used if the species does not reproduce throughout its entire life. This maximum age was estimated as 12 years for wild wolves based upon known age animals in several studies and this value was used in all of the scenarios.

Mortalities: Mortality as a percent (between 0.0 and 100.0) may be included for each age class of immature females and males. Once reproductive age (adult) is reached, the annual probability of mortality remains constant over the life of the animal and is entered only once. The mortality schedule used in all of the scenarios for the Mexican wolves is drawn from studies in ( ). Two levels of adult mortality were included based upon estimates from field studies in Italy ( ) and Minnesota ( ).

The schedule for females and males, with estimated standard deviations are as follows (all as %):

Age	Females	Males
0 - 1	40 ± 10%	40 ± 10%
1 - 2	20 ± 5	20 ± 5
2 - 3	15 ± 4	15 ± 4
Adults	13 ± 3	13 ± 3

Threats: Major potential threats for the populations of Mexican wolves include fragmentation of the remaining habitat, loss of prey species, removal of animals for control purposes, and poaching. Wolves also are known to have been affected by epidemic diseases ( ).

The impact of habitat loss has been modelled by using different carrying capacities as a guide to the changing risk of extinction with decreasing population size. Removals, on a continuing basis were modelled split evenly between the sexes, removed per year. This in effect is a systematic increase in annual adult mortality. Scenarios that included losses due to catastrophes did not include these systematic harvests or removals.

Catastrophes: Catastrophes can be thought of as the extreme of environmental variation. Catastrophes are events that impact either reproduction or survival. Catastrophes can be habitat destruction, floods, fire, disease, poaching etc. Catastrophes do happen and are very real considerations when attempting to model the fate of small populations. The impact of these catastrophes is defined in terms of effects on reproduction and survival. A catastrophe may have occurred when a rate is noted that statistically higher than the normal variation. The reproduction and survival rates for catastrophe years are obtained by multiplying the (non-catastrophe) probability of reproduction or surviving by a severity factor. The severity factor ranges from 0.0 to 1.0. Entering 0.0 indicates a total loss of reproduction or survival for the population and 1.0 indicates that the catastrophe, if it occurs, will have no effect.

Catastrophes in wild wolf populations might include diseases, flooding, drought, unusual reduction of the prey base, and illegal removals. Since resource shortage, disease, and poaching events might be episodic, occurring at uncertain intervals we modelled separately the impact of events occurring on the average either at approximately 2 or 4 (50% or 25% probability - catastrophe 2) or 10 (10% probability - catastrophe 1) year intervals. The event for type 1 (resource depletion or disease) was given a severity effect of either 0.5 or 0.70 on survival (about 50 or 30% additional loss of animals to the population and an 0.80 severity effect on reproduction of the remaining animals. The type 2 event (poaching or removal) was given no effect on reproduction and a 0.95 severity effect on survival reflecting the loss of and additional 5% of the animals. These may underestimate the negative effects on reproduction of the potential social disruptions that may occur.

Age Distribution: We initialized all of the models with a stable age distribution which distributes the total population among the various age classes. The initial population sizes used were 25 for K=25 or 50 and 75 for K=100 or 150. VORTEX automatically enters values for all age classes, proportionate to the stable age distribution.

Base Models: Basic models were constructed from the available life history data using mean adult mortalities of 10% or 13% (column 2 in the tables) followed by systematic variation of carrying capacity, and the 2 catastrophes and with the remaining variables held constant. The parameters systematically varied were carrying capacity at 25, 50, 100, or 150 (column 4 in the tables) and catastrophes (columns 2 and 3) with catastrophe 2 at a frequency of 25 or 50% and catastrophe 1 with a survival severity of 0.5 or 0.7.

Inbreeding: A population with the level of inbreeding depression of one lethal equivalent per diploid genome may have one recessive lethal allele per individual (as in the Recessive Lethals model in VORTEX); or it may have two recessive alleles per individual, each of which confers a 50% decrease in survival; or it may have some combination of recessive deleterious alleles which equate with one fully lethal allele per individual. Natural selection does not remove deleterious alleles at heterotic (or over-dominant) loci (because all alleles in this model are partly deleterious when homozygous), thus the effects of inbreeding are unchanged during repeated generations of inbreeding. The default number of lethal equivalents for the Heterosis model is 3.14 which is a median value obtained in a study of 40 mammalian species (Ralls et al. 1988).

Inbreeding depression has been observed in inbred lines of captive wolves. Negative impacts of inbreeding on reproductive parameters have been described for cheetahs, Asian lions, and Florida panthers ( ). To include this potential threat in these models the Heterosis model in VORTEX was used in which we entered the number of "lethal equivalents" as 1.7. The inclusion of inbreeding was varied systematically in the scenarios developed for the Mexican wolf populations so that comparisons can be made under identical conditions with this factor present or absent.

Results from Simulation Modelling

The simulation scenarios were run 500 times (iterations) with projections for 100 years. Output results were summarized at 10 year intervals and used for the time series figures. Each individual scenario is identified with a file number in column 1 of the tables. The simulations were run using VORTEX version 6.2.

1. Deterministic Results

Growth rate - r: The deterministic growth rate calculated by a Leslie matrix algorithm is recorded in the 5th column in all of the tables. Positive values are necessary for a population to survive and in principle a zero value would characterize a population neither growing or declining. Note in Table 1 that the deterministic growth rate is not sensitive to differences in carrying capacity. It also is not sensitive to the presence of environmental variance included as standard deviations in mortality and reproduction. The addition of catastrophes does reduce the deterministic r since their effects on reproduction and survival are averaged into the calculations of the Leslie matrix, Table 1. It is also not affected by the inclusion of inbreeding (compare File# 011 in Table 1 with 043 in Table 3),

Other Deterministic Values: The generation times in most of the scenarios were about 5-6 years for females and males. Thus a 100 year projection spans about 18 generations. The sex ratio of adult males to females in a stable population was equal. Lambda is calculated from r and can be used for the % annual growth rate (i.e.: [lambda - 1.000] x 100 = annual % growth rate). A stable age distribution for each sex and age class is also presented in Table ?. This will be the same regardless of K if the other values are the same. These are useful estimates for comparison with collected field data on population age structure as a check on census methods or detection of unusual events in the population.

The bar graphs in Figures 1-12 present results from a matrix of scenarios examining the interactions of three variables. The variables are: (1) carrying capacity set at either 25, 50, 100, or 150, (2) catastrophe 1 at a 10% probability of occurrence with a 20% reduction in reproduction and with either a 30 or 50% reduction in survival, and (3) catastrophe 2 at either a 25% or 50% probability of occurrence with no effect on reproduction and a 5% reduction in survival. The bars are arranged in 4 groups of 4 on each Figure. Each group represents the results with the carrying capacity (K) set for the value indicated. The first pair in each group is for a 25% probability for catastrophe II and the second pair for a 50% probability of occurrence. Within each pair the first value is for the 50% reduction in survival and the second is for a 30% reduction in survival.

2. Stochastic Simulation Results

Carrying Capacity: The probability of extinction was sensitive to carrying capacity under all conditions tested, particularly in the range of 25 to 50 animals. The Pe for populations of 25 ranged from 0.3 to 1.0 at 100 years depending upon catastrophes, adult mortality, and the inclusion of inbreeding effects (Figures ?, ?, ?, ?. Extinctions occurred beginning at 20 years and continued at an approximately linear rate during the 100 years of the projections (Figure). Inclusion of catastrophe 1 at a 10% frequency and a 0.7 severity on survival had the most severe effect (Figure) at either 13 or 10% adult mortality rates.

The stochastic r values were also dependent upon carrying capacity (Figures) with rates decreasing with decreasing carrying capacity, becoming negative under some conditions for

K=25. It is noteworthy that the deterministic r values were positive under all of the conditions tested. A deterministic model would yield projections of growing populations under virtually all of the scenarios modelled here. In many of the scenarios, at every population size, there was a significant risk of extinction even with positive stochastic r values.

Mean surviving population sizes were within about 80% of the carrying capacity but with standard deviations ranging from ?? to ?? % of the mean so that the range of surviving population sizes could vary from 20% to 100% of K.

The proportion of starting genetic heterozygosity remaining in the surviving populations ranged from 30 to 80% depending upon the carrying capacity. It was only slightly affected by differences in adult mortality or the catastrophes or inbreeding.

Adult Mortality Reduction of annual male and female adult mortality from 13 to 10% resulted in increased population growth rates and a decreased rate of extinction at all carrying capacities (Figures and Tables). The effects of catastrophes and inbreeding wee also reduced.

The mean surviving populations sizes were about the same at both levels of adult mortality but the standard deviation was less at the lower mortality rate. The mean proportion of heterozygosity remaining was not increased significantly.

Catastrophes The effects of catastrophes are to increase the risk of extinction and decrease the population deterministic and average stochastic growth rates (all figures). The effects of periodic losses whether poaching, controlled removals, or disease are to increase the vulnerability of the population to other stochastic evironmental events such as a rapid decline in the prey base. It is extremely important to include these possibilities in thinking about the hazards that small population may encounter. This has been illustrated in the events occurring with the recovery program for the red wolf as well.

Inbreeding The addition of a small amount of inbreeding to the scenarios resulted in an accelerated risk of extinction and a decrease in the stochastic r values that reflects the increased mortality imposed upon the populations by the inbreeding depression. These efects are readily seen in the figures.

Summary Populations of fewer than 50 wolves (one 1 year old and greater) at a high risk of extinction under the conditions of these scenarios. They are particularly vulnerable to even minimal risks of catastrophes. The addition of minimal inbreeding effects, as has been reported in several studies of captive lineages, further increases this risk of extinction of these small populations. The implications for management over the span of 100 years may include the need for demographic and genetic supplementation or occasional recolonization if complete loss occurs. Populations of 100 or more animals have a less than 5% proability of extinction over the 100 year time period with minimal management to control unregulated removals. Note that even at a carrying capacity the mean population sizes range from 60-90 under stochastic conditions of reproduction and mortality. Thus wide fluctuations in numbers can occur with variations in the environment but the populations could recover rapidly given the positive growth rates (deterministic and stochastic r values). The larger populatins will retain a larger proportion of the starting heterozygosity. They will also regain more heterozygosity through time by mutation. There is a need to further discuss the long term goals of the rcovery program of this subspecies ito assist in habitat planning and in designing managemnt scenarios.

Figure and Table Legends

Figure 1. Probability of extinction at different carrying capacities, 10% adult mortality, no inbreeding, under each of the 4 catastrophe scenarios.

Figure 2. Stochastic growth rates (r) at different carrying capacities, 10% adult mortality, no inbreeding, under each of the 4 catastrophe scenarios.

Figure 3. Mean surving population sizes at different carrying capacities, 10% adult mortality, no inbreeding, under each of the 4 catastrophe scenarios.

Figure 4. Mean expected heterozygosity remaining in the surving populations at different carrying capacities, 10% adult mortality, no inbreeding, under each of the 4 catastrophe scenarios.

Figure 5. Times series of the probability of extinction (Pe) at different carrying capacities, 10% adult mortality, no inbreeding, and with both catastrophes at minimum conditions.

Figure 6. Times series of the probability of extinction (Pe) at at a carrying capacities of 25, 10% adult mortality, no inbreeding, under combinations of the catastrophe scenarios.

Figure 7. Probability of extinction at different carrying capacities, 13% adult mortality, no inbreeding, under each of the 4 catastrophe scenarios.

Figure 8. Stochastic growth rates (r) at different carrying capacities, 13% adult mortality, no inbreeding, under each of the 4 catastrophe scenarios.

Figure 9. Mean surving population sizes at different carrying capacities, 13% adult mortality, no inbreeding, under each of the 4 catastrophe scenarios.

Figure 10. Mean expected heterozygosity remaining in the surving populations at different carrying capacities, 13% adult mortality, no inbreeding, under each of the 4 catastrophe scenarios.

Figure 11. Times series of the probability of extinction (Pe) at different carrying capacities, 13% adult mortality, no inbreeding, and with both catastrophes at minimum conditions.

Figure 12. Times series of the probability of extinction (Pe) at at a carrying capacities of 25, 13% adult mortality, no inbreeding, under combinations of the catastrophe scenarios.

Figure 13. Probability of extinction at different carrying capacities, 13% adult mortality, with inbreeding LE = 1.7, under each of the 4 catastrophe scenarios.

Figure 14. Stochastic growth rates (r) at different carrying capacities, 13% adult mortality, with inbreeding LE = 1.7, under each of the 4 catastrophe scenarios.

Figure 15. Mean surving population sizes at different carrying capacities, 13% adult mortality, with inbreeding LE = 1.7, under each of the 4 catastrophe scenarios.

Figure 16. Mean expected heterozygosity remaining in the surving populations at different carrying capacities, 13% adult mortality, with inbreeding LE = 1.7, under each of the 4 catastrophe scenarios.

Figure 17. Times series of the probability of extinction (Pe) at different carrying capacities, 13% adult mortality, with inbreeding LE = 1.7, and with both catastrophes at minimum conditions.

Figure 18. Times series of the probability of extinction (Pe) at at a carrying capacities of 25, 13% adult mortality, with inbreeding LE = 1.7, under combinations of the catastrophe scenarios.

Figure 19. Times series of the heterozygosity remaining in the surviving populations at

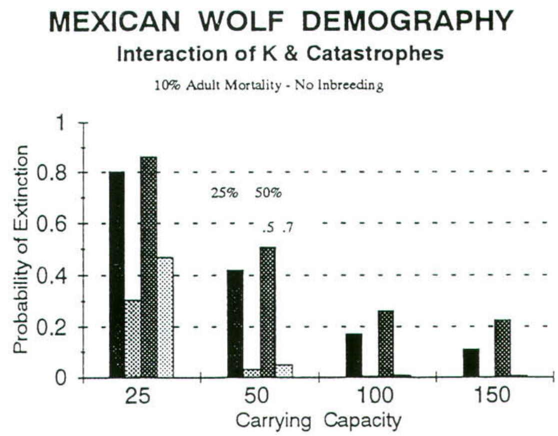
different carrying capacities, 13% adult mortality, no inbreeding, and with both catastrophes at minimum conditions.

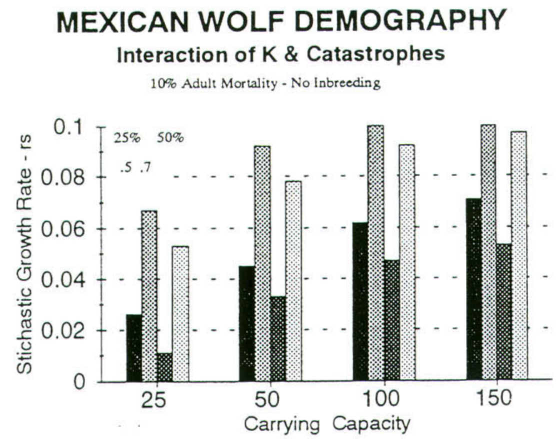
Figure 20. Times series of the heterozygosity remaining in the surviving populations at at a carrying capacities of 25, 13% adult mortality, no inbreeding, under combinations of the catastrophe scenarios.

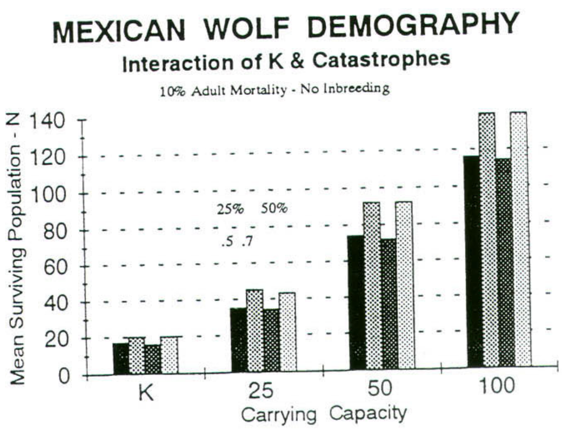
Figure 21. Times series of the heterozygosity remaining in the surviving populations at different carrying capacities, 10% adult mortality, no inbreeding, and with both catastrophes at minimum conditions.

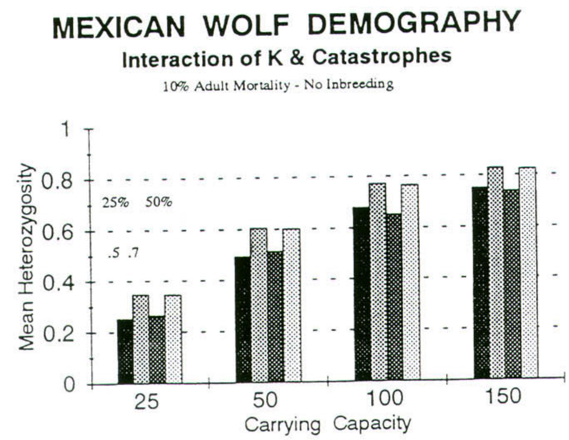
Figure 22. Times series of the heterozygosity remaining in the surviving populations at at a carrying capacities of 25, 10% adult mortality, no inbreeding, under combinations of the catastrophe scenarios.

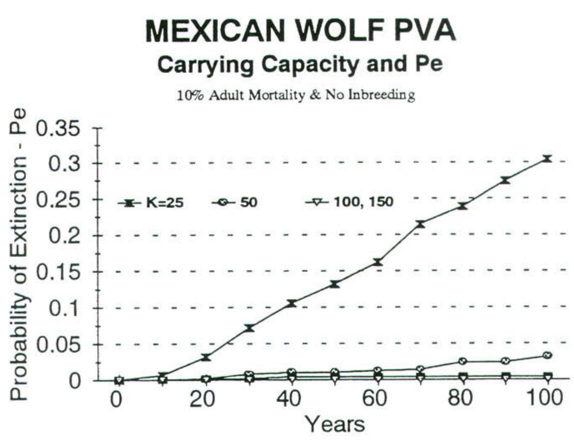
Table 1. Effects of carrying capacity on probability on Mexican Wolf populations simulated with the VORTEX models. Conditions for all of the simulations were (1) age of first reproduction for males and females = 3 years, (2) litter size 1-9 with a mean of 4.5 and 50% ± 10% of females not having a litter; proportion of litter sizes: 1=2%, 2=4%, 3=6%, 4=8%, 5=14%, 6=6%, 7=6%, 8=4%, and 9=2%, (3) mortality by age classes of 1 yr - 40% ± 10%SD, 2 yr - 20% ± 5%, 3 yr - 15 ± 3%, and 10% ± 2% for animals ≥ 3 years, (4) starting population for each sex of 5 one year-olds, 4 two year-olds, and 10 adults, (5) runs were for 100 years, (6) no harvest or supplementations, and (7) 1000 runs of each scenario. The type I catastrophe was set at a probability of either 25 or 50% with no effect on reproduction, and a 0.95 effect on survival to simulate stochastic removal of 5% of the population on the average every 4 or 2 years as might happen through a combination of poaching and road kills. The Type II catastrophe was set at a probability of 10% with a 0.8 effect on reproduction and either a 0.5 or 0.7 effect on survival to simulate a 50 to 30% mortality from disease with a 20% decrease in reproduction from less frequent disease or disruption events.

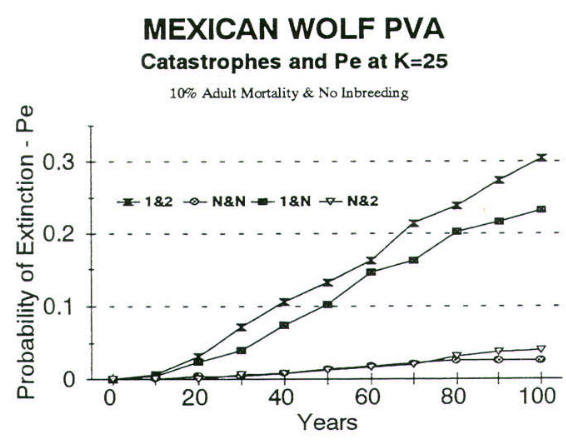

MEXICAN WOLF DEMOGRAPHY
Interaction of K & Catastrophes
10% Adult Mortality - No Inbreeding
Probability of Extinction
25% 50%
.5 .7
Carrying Capacity
1
0.8
0.6
0.4
0.2
0
25
50
100
150

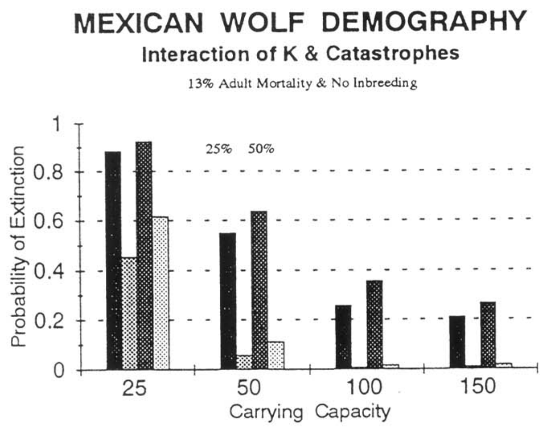

MEXICAN WOLF DEMOGRAPHY
Interaction of K & Catastrophes
10% Adult Mortality - No Inbreeding
Stichastic Growth Rate - rs
25% 50%
.5 .7
Carrying Capacity
0.1
0.08
0.06
0.04
0.02
0
25
50
100
150

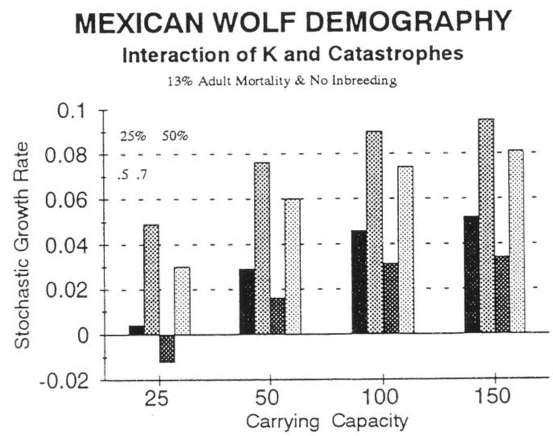

MEXICAN WOLF DEMOGRAPHY
Interaction of K & Catastrophes
10% Adult Mortality - No Inbreeding
Mean Surviving Population - N
25% 50%
.5 .7
Carrying Capacity
140
120
100
80
60
40
20
0
K
25
50
100

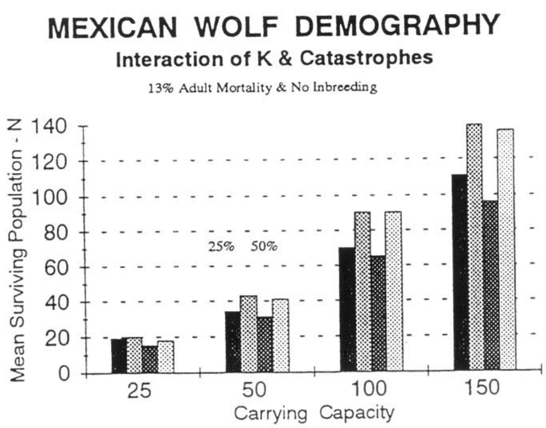

MEXICAN WOLF DEMOGRAPHY
Interaction of K & Catastrophes
10% Adult Mortality - No Inbreeding
Mean Heterozygosity
25% 50%
.5 .7
Carrying Capacity
1
0.8
0.6
0.4
0.2
0
25
50
100
150

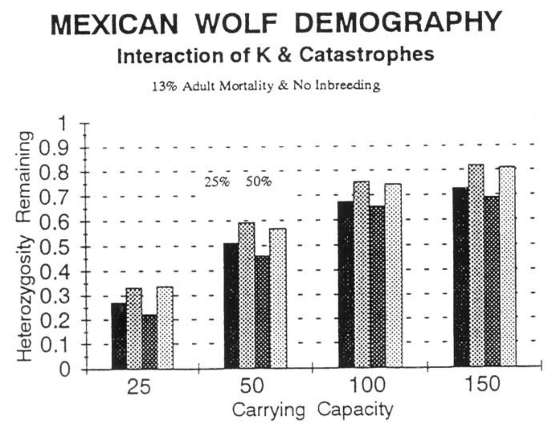

MEXICAN WOLF PVA
Carrying Capacity and Pe
10% Adult Mortality & No Inbreeding
Probability of Extinction - Pe
K=25
50
100, 150
Years
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
20
40
60
80
100

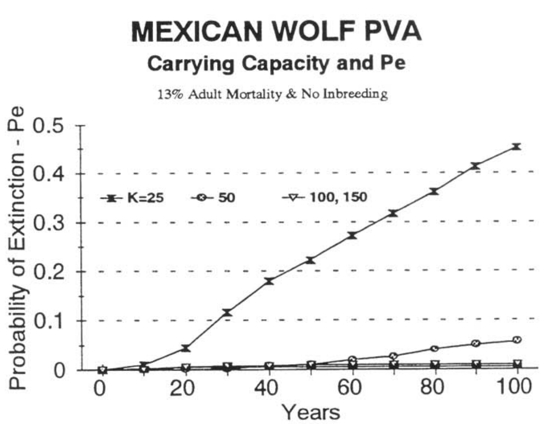

MEXICAN WOLF PVA
Catastrophes and Pe at K=25
10% Adult Mortality & No Inbreeding
Probability of Extinction - Pe
1&2
N&N
1&N
N&2
Years
0.3
0.2
0.1
0
0
20
40
60
80
100

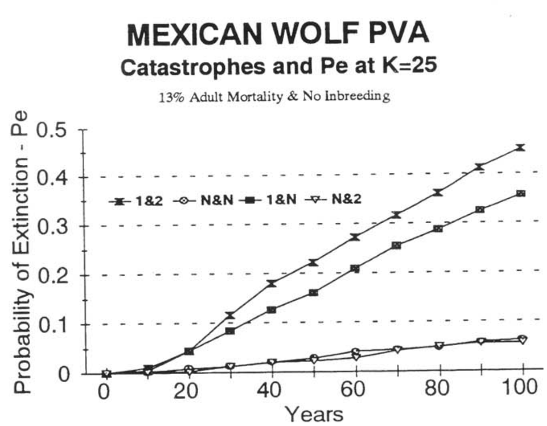

MEXICAN WOLF DEMOGRAPHY
Interaction of K & Catastrophes
13% Adult Mortality & No Inbreeding
25% 50%
Probability of Extinction
Carrying Capacity

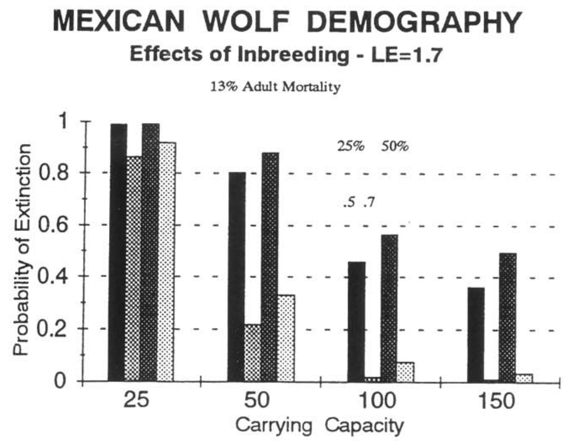

MEXICAN WOLF DEMOGRAPHY
Interaction of K and Catastrophes
13% Adult Mortality & No Inbreeding
25% 50%
.5 .7
Stochastic Growth Rate
Carrying Capacity

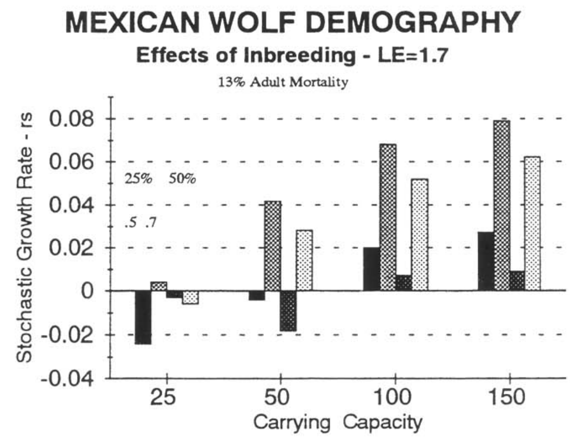

MEXICAN WOLF DEMOGRAPHY
Interaction of K & Catastrophes
13% Adult Mortality & No Inbreeding
25% 50%
Mean Surviving Population - N
Carrying Capacity

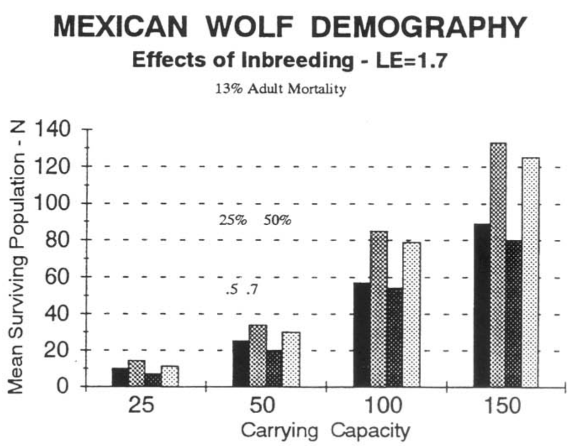

MEXICAN WOLF DEMOGRAPHY
Interaction of K & Catastrophes
13% Adult Mortality & No Inbreeding
25% 50%
Heterozygosity Remaining
Carrying Capacity

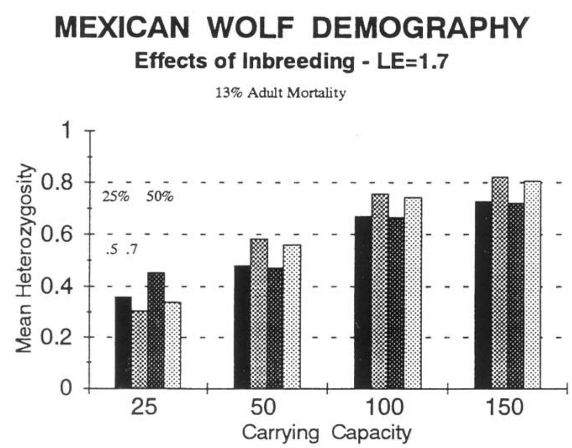

MEXICAN WOLF PVA
Carrying Capacity and Pe
13% Adult Mortality & No Inbreeding
K=25 50 100, 150
Probability of Extinction - Pe
Years

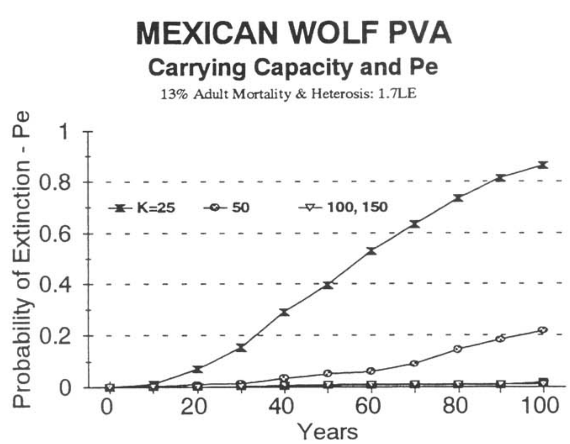

MEXICAN WOLF PVA
Catastrophes and Pe at K=25
13% Adult Mortality & No Inbreeding
1&2 N&N 1&N N&2
Probability of Extinction - Pe
Years

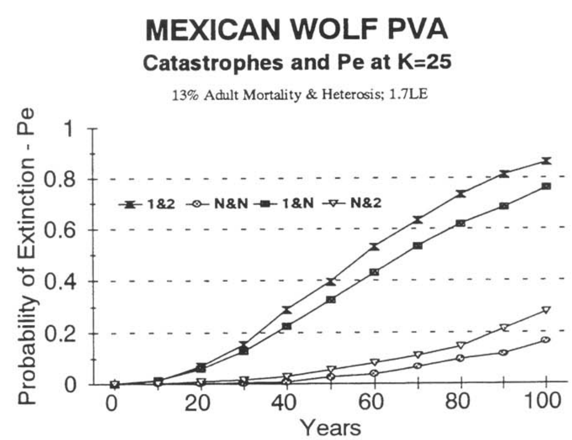

MEXICAN WOLF DEMOGRAPHY
Effects of Inbreeding - LE=1.7
13% Adult Mortality
Probability of Extinction
25% 50%
.5 .7
Carrying Capacity

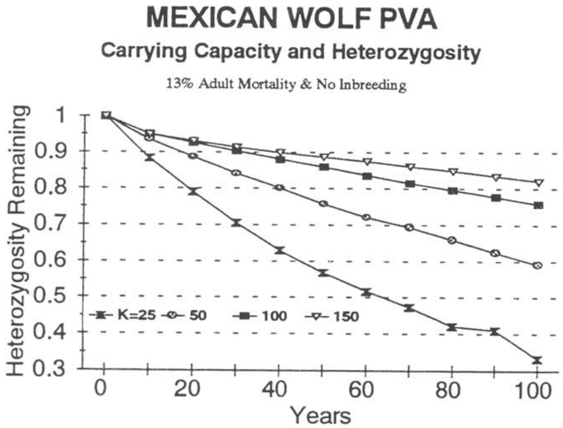

MEXICAN WOLF DEMOGRAPHY
Effects of Inbreeding - LE=1.7
13% Adult Mortality
Stochastic Growth Rate - rs
25% 50%
.5 .7
Carrying Capacity

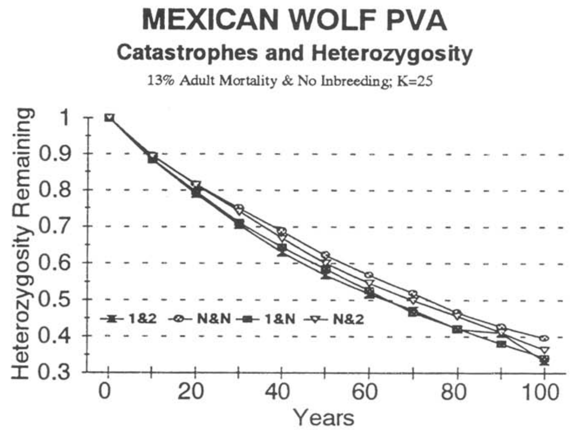

MEXICAN WOLF DEMOGRAPHY
Effects of Inbreeding - LE=1.7
13% Adult Mortality
Mean Surviving Population - N
25% 50%
.5 .7
Carrying Capacity

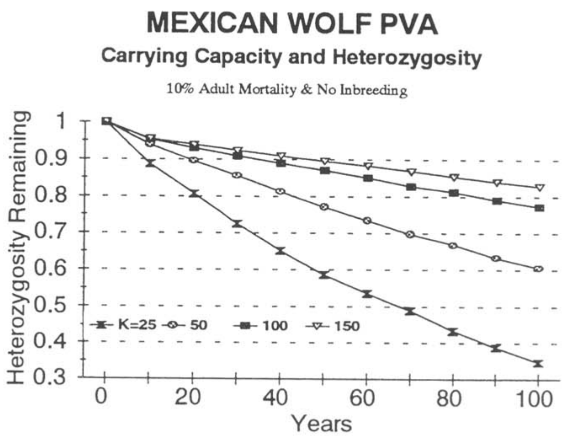

MEXICAN WOLF DEMOGRAPHY
Effects of Inbreeding - LE=1.7
13% Adult Mortality
Mean Heterozygosity
25% 50%
.5 .7
Carrying Capacity


MEXICAN WOLF PVA
Carrying Capacity and Pe
13% Adult Mortality & Heterosis: 1.7LE
Probability of Extinction - Pe
K=25
50
100, 150
Years


MEXICAN WOLF PVA
Catastrophes and Pe at K=25
13% Adult Mortality & Heterosis; 1.7LE
Probability of Extinction - Pe
1&2
N&N
1&N
N&2
Years


MEXICAN WOLF PVA
Carrying Capacity and Heterozygosity
13% Adult Mortality & No Inbreeding
Heterozygosity Remaining
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
K=25
50
100
150
0
20
40
60
80
100
Years


MEXICAN WOLF PVA
Catastrophes and Heterozygosity
13% Adult Mortality & No Inbreeding; K=25
Heterozygosity Remaining
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
1&2
N&N
1&N
N&2
0
20
40
60
80
100
Years


MEXICAN WOLF PVA
Carrying Capacity and Heterozygosity
10% Adult Mortality & No Inbreeding
Heterozygosity Remaining
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
K=25
50
100
150
0
20
40
60
80
100
Years

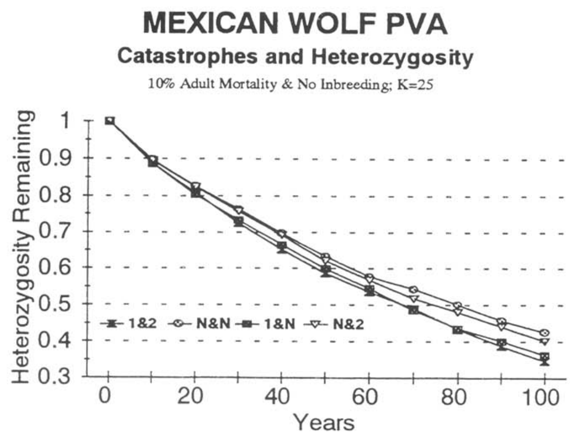

MEXICAN WOLF PVA
Catastrophes and Heterozygosity
10% Adult Mortality & No Inbreeding; K=25
Heterozygosity Remaining
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
1&2
N&N
1&N
N&2
0
20
40
60
80
100
Years

Table 1. MEXICAN WOLF - 50% Males Breed, 13% Adult Mortality, No Inbreeding											
File #				Results							
	Cat #2 Freq	Cat #1 Sur	K #	Population Growth			100 Years				Te
				Deter r	Stochastic r	SD	Pe	N	SD	He	
Catas: #1, 10%f, 1.0 Rep; #2, 1.0 Rep, .95 Sur											
011	25	.5	25	.116	.002	.352	.856	17	7	.235	42
010		.7		.136	.046	.254	.332	19	6	.328	52
013	50	.5		.103	-.006	.350	.868	16	8	.247	38
012		.7		.124	.029	.267	.484	19	6	.299	52
015	25	.5	50	.116	.025	.304	.504	34	15	.459	52
014		.7		.136	.069	.207	.044	43	11	.585	58
017	50	.5		.103	.008	.315	.600	30	16	.409	53
016		.7		.124	.054	.214	.104	41	12	.564	60
019	25	.5	100	.116	.041	.280	.248	68	32	.644	50
018		.7		.136	.087	.180	.014	93	13	.756	35
021	50	.5		.103	.027	.288	.342	63	33	.639	49
020		.7		.124	.072	.185	.014	89	18	.740	50
023	25	.5	150	.116	.045	.276	.226	105	46	.719	43
022		.7		.136	.091	.174	.006	139	19	.806	38
025	50	.5		.103	.031	.281	.294	99	49	.692	40
024		.7		.124	.078	.176	.020	138	21	.803	40
Effects of Removal of Catastrophes											
A10	N	N	25	.183	.101	.196	.008	23	4	.390	46
A14			50		.126	.151	0	49	4	.637	
A18			100		.140	.126	0	99	5	.786	
A22			150		.146	.118	0	148	6	.842	
C10	N	.7	25	.149	.059	.248	.276	20	6	.328	51
C14			50		.085	.201	.022	44	9	.591	48
C18			100		.101	.177	.002	94	13	.765	18
C22			150		.105	.171	.002	143	16	.821	14
E10	25	N	25	.171	.089	.199	.040	23	4	.386	69
E14			50		.113	.155	0	48	4	.619	
E18			100		.127	.130	0	99	5	.782	
E22			150		.132	.120	0	149	6	.838	

Table 2. MEXICAN WOLF - 50% Males Breed, 10% Adult Mortality, No Inbreeding

File #	Cat #2	Cat #1	K	Results: Population Growth: Deter r	Stochastic r	SD	100 Years: Pe	N	SD	He	Te
Catas: #1, 10%f, 1.0 Rep; #2, 1.0 Rep, .95 Sur											
027	25	.5	25	.130	.023	.338	.742	18	7	.323	44
026		.7		.151	.061	.249	.246	20	6	.376	54
029	50	.5		.118	.006	.345	.804	16	8	.269	42
028		.7		.138	.049	.253	.328	20	6	.339	53
031	25	.5	50	.130	.044	.298	.362	36	15	.507	50
030		.7		.151	.087	.201	.012	44	9	.614	68
033	50	.5		.118	.028	.306	.470	32	15	.450	52
032		.7		.138	.074	.204	.040	43	10	.600	47
035	25	.5	100	.130	.059	.276	.176	73	31	.671	54
034		.7		.151	.102	.177	.004	94	13	.768	22
037	50	.5		.118	.045	.279	.214	70	32	.652	51
036		.7		.138	.088	.181	.006	91	15	.760	39
039	25	.5	150	.130	.067	.264	.108	117	43	.754	42
038		.7		.151	.108	.172	.004	142	17	.822	44
041	50	.5		.118	.053	.268	.174	110	46	.740	42
040		.7		.138	.096	.171	0	140	18	.821	
Effects of Removal of Catastrophes											
B26	N	N	25	.198	.118	.192	.006	23	3	.418	31
B30			50		.143	.150	0	49	4	.645	
B34			100		.157	.125	0	99	4	.795	
B38			150		.162	.116	0	149	6	.847	
D26	N	.7	25	.164	.078	.242	.146	20	6	.354	52
D30			50		.101	.198	.008	45	8	.619	55
D34			100		.117	.175	0	94	13	.780	
D38			150		.122	.168	.002	144	15	.837	26
F26	25	N	25	.185	.106	.197	.018	23	3	.417	59
F30			50		.130	.152	0	49	4	.643	
F34			100		.143	.127	0	99	5	.796	
F38			150		.149	.119	0	149	6	.843	

Table 3. MEXICAN WOLF - 50% Males Breed, 13% Adult Mortality, Heterosis-1.7LE

File #	Cat	Cat	K	Results: Population Growth	100 Years	

				Deter r	Stochastic r	SD	Pe	N	SD	He	
Catas: #1, 10%f, 1.0 Rep; #2, 1.0 Rep, .95 Sur											
043	25	.5	25	.116	-.027	.349	.978	10	6	.255	40
042		.7		.136	.001	.266	.832	12	6	.289	58
045	50	.5		.103	-.040	.352	.992	9	5	.350	36
044		.7		.124	-.010	.275	.912	11	6	.238	53
047	25	.5	50	.116	-.006	.310	.810	23	15	.529	55
046		.7		.136	.036	.212	.232	32	15	.584	68
049	50	.5		.103	-.021	.318	.870	17	12	.445	50
048		.7		.124	.022	.219	.320	29	15	.560	70
051	25	.5	100	.116	.016	.283	.470	54	35	.654	58
050		.7		.136	.066	.180	.022	85	21	.756	52
053	50	.5		.103	-.005	.295	.628	43	34	.611	56
052		.7		.124	.050	.186	.072	78	25	.745	68
055	25	.5	150	.116	.025	.276	.350	87	53	.732	52
054		.7		.136	.076	.172	.020	135	26	.813	44
057	50	.5		.103	.004	.288	.522	79	50	.711	53
056		.7		.124	.057	.179	.068	128	32	.802	50
Effects of Removing Catastrophes											
G42	N	N	25	.183	.057	.189	.132	19	6	.427	79
G46			50		.101	.145	0	48	5	.653	
G50			100		.124	.122	0	99	5	.793	
G54			150								
I42	N	.7	25	.149	.012	.254	.722	14	7	.360	73
I46			50		.054	.200	.092	37	14	.603	75
I50			100		.079	.177	.004	89	18	.763	83
I54			150		.092	.168	.002	138	22	.825	19
L42	25	N	25	.171	.042	.201	.250	17	7	.402	71
L46			50		.086	.149	.002	47	5	.649	84
L50			100		.111	.126	0	98	5	.791	
L54			150		.120	.117	0	148	6	.847	

Table 4. MEXICAN WOLF - 50% Males Breed, 10% Adult Mortality, Heterosis-1.7LE

File #				Results							
	Cat #2	Cat #1	K	Population Growth			100 Years				Te
				Deter r	Stochastic r	SD	Pe	N	SD	He	
Catas: #1, 10%f, 1.0 Rep; #2, 1.0 Rep, .95 Sur											

Table 4. MEXICAN WOLF - 50% Males Breed, 10% Adult Mortality, Heterosis-1.7LE

File #	Cat #2	Cat #1	K	Results: Population Growth: Deter r	Stochastic r	Stochastic SD	100 Years: Pe	N	SD	He	Te
059	25	.5	25	.130	-.011	.339	.946	13	6	.333	43
058		.7		.151	.016	.255	.672	14	7	.385	62
061	50	.5		.118	-.021	.342	.968	15	9	.223	41
060		.7		.138	.004	.262	.796	12	7	.314	58
063	25	.5	50	.130	.012	.304	.674	24	16	.494	57
062		.7		.151	.058	.200	.088	38	13	.602	74
065	50	.5		.118	-.003	.310	.772	23	15	.506	56
064		.7		.138	.044	.205	.148	35	14	.584	67
067	25	.5	100	.130	.038	.272	.284	61	34	.684	56
066		.7		.151	.084	.175	.004	89	18	.772	74
069	50	.5		.118	.018	.286	.452	55	36	.675	56
068		.7		.138	.071	.179	.024	86	20	.767	38
071	25	.5	150	.130	.045	.267	.222	98	48	.753	50
070		.7		.151	.094	.168	.002	139	20	.831	69
073	50	.5		.118							
072		.7		.138	.080	.172	.020	134	25	.823	52
Effects of Removing Catastrophes											
H58	N	N	25	.198	.079	.180	.056	21	5	.439	72
H62			50		.119	1.44	0	48	4	.664	
H66			100		.141	.121	0	99	5	.801	
H70			150								
J58	N	.7	25	.164	.033	.243	.476	15	7	.359	65
J62			50		.075	.194	.024	41	11	.616	76
J66			100		.100	.173	0	93	13	.783	
J70			150		.109	.165	0	142	17	.835	
L58	25	N	25	.185	.063	.188	.092	20	5	.434	75
L62			50		.106	.145	0	48	5	.672	
L66			100		.128	.123	0	98	5	.799	
L79			150		.136	.116	0	149	6	.846	

Canis lupus baileyi

Population Viability Assessment

SECTION 3

SYSTEMATICS AND MOLECULAR GENETICS

Mexican Wolf PVA - Genetics

Statement of Problem

<u>Genetic distinctiveness</u>

Many subspecies of gray wolves have been defined in North America based primarily on morphologic criteria. Considering the high mobility of gray wolves, many of these subspecies may not reflect genuine differentiated populations. More over, many of the subspecies are now extinct over the distribution of gray wolf. Prior analysis using Allozyme electrophoresis has not revealed fixed allele differences between populations of gray wolves. Recent mitochondrial DNA (mtDNA) analysis have similarly suggested that all North American wolves are not well differentiated genetically due to high gene flow among Canadian and Alaskan populations. However, restriction site analysis of the Mexican wolf has suggested that all sampled Mexican wolves share a unique mtDNA genotype not found in any other gray wolf or in a comprehensive sample of domestic dogs, coyote or red wolf. Relative to the amount of restriction site differences observed among gray wolves, we feel that the genetic distinctiveness of the Mexican wolf warrants its classification as a separate subspecies.

Analysis of 120 blood samples of Canids collected in northeast Texas in 1974-75 and polymerase chain reaction (PCR) amplified DNA sequence from museum pelts from Texas and Louisiana, indicates that the characteristic Mexican wolf genotype was present in 3 Canids from these localities as early as 1910. Therefore, we believe this is evidence that Mexican wolves existed in the southern United States.

<u>Genetic Variability</u>

Small captive populations often lose substantial genetic variability through inbreeding and genetic drift. Such losses in variability are often associated with reduction in fitness such as high juvenile mortality, infertility or susceptibility to disease. Genetic variability was assessed in a sample of 22 captive individuals using allozyme electrophoresis. Allelic variation was found in 5 of 22 loci, a value identical to that found in 5 populations of gray wolves. Similarly, the value of heterozygosity in the captive population, 0.11, is as great or greater as that of the wild population of gray wolves. Therefore, we conclude, relative to wild populations of gray wolf, there have been no apparent decreases in heterozygosity in the sample captive population.

<u>Hybridization</u>

Gray wolves, coyotes and domestic dogs are known to hybridize and have fertile offspring in captivity. Hybridization in the wild has been suspected on morphological and behavioral observations. Recent mtDNA evidence suggests hybridization has occurred in areas of Minnesota, Ontario, and Quebec (Lehman et al, in press). The data indicate that hybridization has taken place a minimum of 6 times in a population of several thousand wolves. Hybridization is most likely occurring between wolves and coyotes where young dispersing male wolves venture into areas where coyotes are abundant and wolves are rare. Mexican wolves are presently threatened in the wild with hybridization with coyotes and feral domestic dogs. Reintroduced populations in Arizona and elsewhere are likely to suffer from the same threats.

Purity of Captive Populations

Presently there are three principle captive lineages. The certified lineage consists of animals that have descended from wild caught Mexican wolves in the states of Durango and Chihuahua. The uncertified lineage consists of descendants of a certified Mexican wolf female and a wild caught wolf from southern Arizona that may have some dog ancestry based on appearance. The third lineage consists of a group of Mexican wolves held in the Aragon Zoo of uncertain ancestry.

MtDNA analysis of the certified and uncertified lineages indicates they have the Mexican wolf genotype. However, this indicates only that the female founders were of Mexican wolf derivation, whereas the males have not been verified as being of Mexican wolf origin. This is critical for the uncertified lineage, which was founded by a male of uncertain history. The Aragon population has been examined with morphologic techniques and allozyme electrophoresis. The latter technique was inconclusive, whereas the morphological analysis suggested affinity with Mexican wolves and not dogs or coyotes.

Statement of Research Problems

Genetic Distinctiveness

Genetic differences between Mexican wolves and other populations of extant wolves, coyotes and domestic dogs need to be better characterized with nuclear based markers. Also, the historic distribution of Mexican wolves needs to be examined using museum collections and PCR amplifications of DNA sequences.

Genetic variability

Considering the small size of the captive populations; genetic variability is likely to be lost due to inbreeding and genetic drift. More over breeding strategies to minimize the loss of genetic variability should be developed. Analysis of nuclear genes should be used to monitor both reduction in genetic variability and to select individuals for breeding which are least similar genetically.

Hybridization

Reintroduced wolves may potentially hybridize with wild and feral Canids. Nuclear markers need to be developed to effectively test offspring of reintroduced Mexican wolves. More over, populations of Canids in the reintroduction site should be genetically characterized prior to reintroduction.

Purity of Captive Population

All putative Mexican wolves need to be characterized with nuclear based markers. A special immediate need is to type the Aragon population using established mtDNA techniques to determine whether this population may be suitable for participation in the Mexican wolf breeding program.

Methodological Approaches

MtDNA restriction site and PCR DNA sequence analysis

Captive populations of wolves that have not yet been sampled should be analyzed for the diagnostic presence of the Bgl I restriction site polymorphism characteristic of Mexican wolves. Samples of wolves from throughout Mexico and southwest United States should be obtained from the Smithsonian fur vault collection for PCR amplification of mtDNA sequences. This will permit us to determine the geographic areas where the Mexican wolf genotype was present in the past as well as determine the validity of named subspecies in the American southwest.

Nuclear gene analysis

Several known polymorphic probes will be used in a southern blot analysis of DNA from Mexican wolves, other gray wolves, domestic dogs and coyotes to identify polymorphic markers that distinguish Mexican wolves from other canids. These probes include a major histocompatibility complex (MHC) probe developed for carnivores, single and multiple locus hypervariable mini-satellite probes and single locus microsatellite probes developed for the domestic dog. Because these probes may not reveal diagnostic markers for the Mexican wolf, a genomic library should be screened with heterologous hypervariable probes developed for humans obtained from the American Type Culture Collection (ATCC). DNA isolated from mini-preps of positive clones will be screened for polymorphic restriction site variance in a panel of DNA from Mexican wolf, gray wolf, red wolf, domestic dog and coyote.

We will also develop an approach that will detect nuclear polymorphisms in recent and historic samples of Canid tissue using PCR of specific DNA sequences. John Patton (LGL Ecological Genetics) will use the technique of randomly accessed polymorphic DNA (RAPD) to uncover sequence variance characteristics of the Mexican wolf. Also, Robert Wayne (UCLA) will attempt to use PCR on sequences flanking a variable number tandem repeat (VNTR) that has been identified in domestic dogs by Dr. Richard Squires (University of Edinburgh). This approach will potentially allow us to rapidly determine both the purity of extant Mexican wolves, as well as to determine the affinities of historic samples from the American southwest and Mexico (see above).

The immediate priorities are the following:

Priority 1. Identification of specific nuclear markers that distinguish Mexican wolves from other wild canids. This immediate effort will involve RAPD screening by John Patton and restriction fragment length polymorphism (RFLP) screening with polymorphic probes by Robert Wayne.

Priority 2. Screening of commercial dog genomic libraries to obtain additional polymorphic loci probes to help differentiate canids.

Priority 3. PCR amplification of DNA from historic specimens from throughout the former range of the Mexican wolf.

Materials and Supplies Requested

1. Biological samples.

An immediate need is blood samples from all captive Mexican wolves. Also, samples from wild Mexican wolves captured as part of the Mexican Wolf Recovery Project, or killed incidentally are needed. Additionally, samples from coyotes, dogs and other canids in areas where Mexican wolves may be present need to be collected. Hair, skin, muscle or samples of any tissue are needed from wild wolves and other canids that may be killed incidentally by trappers or vehicles. Samples of any age and kept under any conditions are valuable and may be potentially used for analysis. Finally, samples of pelts or bones in museum collections need to be collected from wolves over the entire historic range of the Mexican wolf.

2. Supplies

Supplies are requested for the above analyses that will be done in the laboratories of Dr. Robert Wayne, Dept. of Biology, UCLA and Dr. John Patton, Ecological Genetics.

a. MtDNA restriction site typing of unsurveyed wolves (Wayne)....$250.00 (PRIORITY 1)

b. Polymorphic screen with MHC and VNTR probes (Wayne).....$10000.00 (PRIORITY 1)

c. Randomly accessed polymorphic DNA (RAPD) analysis of extant samples of canids (Patton)....$10000.00 (PRIORITY 1)

d. Cloning and screening of wolf specific polymorphic nuclear probes (Wayne & Patton)......$20000.00 (PRIORITY 2)

e. PCR amplification and sequencing of mtDNA and nuclear genes from historic specimens (Wayne)......$15000.00 (PRIORITY 3)

3. Personnel

We strongly recommend a Mexican graduate student should be given a one year stipend to do the research in the laboratories of Wayne and Patton........$16,000.

Time Table

a. mtDNA restriction site analysis of unsurveyed wolves......one month from receipt of samples
b. Polymorphic screen......3 months
c. RAPD....................3 months
d. Wolf specific probes...12 months
e. PCR amplification.......9 months

PROTOCOL FOR THE COLLECTION OF GENETIC SAMPLES

BLOOD SAMPLES:

1. Draw blood samples in vacutainer tube with HEPARIN (0.2cc/10cc blood) (Sodium Heparin, 1000 units/ml)

Choose one of the following (listed in order of preference and best results).

2a)* Send whole blood sample in styrofoam container with ice pack on next day air (place paper towels between sample and ice pack to avoid freezing of blood). We must receive samples within one week (1-2 days best).

2b) Process the blood according to attached protocol, store in freezer, and send components on dry ice.

2c) Spin blood once, remove plasma to just above buffy (white cell) coat, place in freeze vial. Remove buffy coat plus several millimeters of red cells below buffer coat and place in second freeze vial (volume should be approx. 1ml). Remove 1ml of packed red cells, place in freeze vial. Label and freeze all three components, ship on dry ice.

2d) Keep whole blood on cool pack and freeze ASAP. Send on dry ice.

2e) For field biologists without refrigeration (least desirable method). Place 5-10ml whole blood in equal volume of the following preservative solution; 100mm tris pH. 8.0, 100mm EDTA, 2% SDS (Sodium Dodecyl Sulfate). I would be happy to send you the solution or dry reagents measured for 500ml volume of DH20. However, any University lab will have these reagents. You may then store blood at room or cool temperatures for several months.

TISSUE SAMPLE:

1a) Place half dollar size piece (50g, 1-2cm) of heart, skeletal muscle, kidney, liver (in order of preference) or any other tissue in ziplock bag. Label and freeze ASAP. Or

1b) If there is no access to refrigeration, chop up samples into 1mm pieces and place in a container with the preservative in (2e) above or 90% EtOH. We prefer (1a) if possible.

Samples can be sent to:

Dr. Robert K. Wayne
Department of Biology
621 Circle Drive South U.C. Los Angeles
Los Angeles, CA 90024
TEL: 213-825-9110 (w) 213-470-8968 (h)
FAX: 213-206-3987

P.S. Just FAX or write if you need any supplies. THANKS!!

MEXICAN WOLF

Canis lupus baileyi

Population Viability Assessment

SECTION 4

WILD POPULATIONS

Review of Wild Populations of Mexican Wolves

MEXICO

In the late 1970s McBride (1980) surveyed wolf populations in the wild in the Mexican states of Chihuahua, Durango, Sonora and Zacatecas. He concluded that, at that time, "less than 50 Mexican wolves exist in their native Sierra Madre range in the Mexican states of Chihuahua and Durango." Subsequent estimates by McBride and Jose Trevino (pers.comm.) continued to drop, and Trevino (MWRT,1981) estimated "that 30 or less remained" in 1981, primarily in the Sierra del Nido on the border between Chihuahua and Sonora and in an area southwest of Durango.

In 1984, El Centro Ecologico del Desierto in Hermosillo "requested help in locating a knowledgeable wolf trapper, whom they would pay to capture wolves reported on a ranch in Sonora "(MWRT,1984). Although this effort came to naught, it was evidence of continuing presence of wild wolves in that state.

Hernandez, Lafon and Gallina (Hernandez et al, 1985) surveyed areas in Chihuahua and Durango in which Leopold (1972) and McBride (1980) had reported presence of wolves. They reported hearing a wolf howl in southern Durango. Also, in Durango, they collected one pelt and one skull that L.D. Mech and Luigi Boitani judged to be from a possible wolf-dog hybrid.

More recently, Servin (1986) reported a pair of wolves present in the Sierra del Promontorio in Durango. In 1989 a native ethnic group reported at least three wolves present in southwestern Durango. Access to this land is controlled, and the ethnic group does not allow trapping. Two wolves were reported by a rancher in northwestern Zacatecas during 1989 and 1990. Although reports from this area have been rare during recent years, the familiarity of the ranching family with wolves lends credibility to these reports. Most recently, the Centro Ecologico del Desierto reported a sighting of six wolves on the Sonoran/Chihuahuan border south of the U.S. border. A final location from which several unconfirmed reports have been received is the western Sierra de Madre near the U.S. border at Nogales, Arizona.

SURVEY NEEDS

The extent and viability of wild Mexican wolf populations in Mexico is unknown. Management decisions concerning wolves in Mexico, including their recovery potential or availability for captive stock, need to be based upon more complete information about the status and distribution of existing populations. An expanded survey effort should be the first step in assessing the status of Mexican wolf populations in Mexico. Funding and manpower support have not been available to address this need adequately in the past.

Four general localities should receive prioritization for surveys: The region along the border of Sonora and Chihuahua; the Sierra las Tunas in Chihuahua; southwestern Durango; and northwestern Zacatecas.

Three groups are currently involved in Mexican wolf investigations in Mexico. One is a group from the Universidad Nacional de Mexico appointed by the government to conduct endangered species surveys in association with a forestry development project funded by the World Bank. This group will be working in the Sierra Madre in the western portions of Chihuahua and Durango. Although the personnel are currently limited in experience in Mexican wolf research, plans are underway for them to receive training in wolf detection from Julio Carrera and Roy McBride.

The other two groups have considerably more experience in Mexican wolf research. They are the Coahuila and Chihuahua research groups of PROFAUNA (Proteccion de la Fauna Mexicana A.C.), a non-governmental organization directed by Dr. Julio Carrera. These researchers have established a good working rapport with landowners and local individuals during previous Mexican wolf research. Plans are underway to utilize baited light-trip cameras provided by a group from Norway in surveys in Zacatecas next summer.

RECOMMENDATIONS

* Monetary support should be established for a thorough survey for Mexican wolves in those portions of Mexico considered to be of highest potential. Methods should include a questionnaire distributed to local landowners, followed by track and howling surveys.

* To the greatest extent possible, surveys should be conducted by local researchers with experience in Mexican wolf research and local familiarity.

* Results of surveys should be used to determine future management potential. There is strong concern that removal of wolves from the wild in the past has shifted priority and attention from the potential of existing wild populations to the captive breeding effort. Utilization of wild Mexican wolves for captive stock should not preclude the potential for recovery of wild populations through intensive management where that potential exists.

* Wolf locations identified should be mapped. Results should be analyzed to propose site selection and design of preserves to recover appropriate extant populations or serve as reintroduction sites.

* Potential recovery locations for wild populations should be investigated further. Habitat parameters, including prey base, water availability, land use and land ownership, should be determined. Blood samples should be collected from local dog and coyote populations to check for evidence of hybridization through mitochondrial and nuclear DNA analysis.

* Utilization of wild stock for supplementation of captive populations should consider several options based upon the apparent status of the wild population, including removal of adults versus young or collection of semen for artificial insemination.

* Education efforts need to accompany and follow the survey effort in order to solicit

landowner cooperation and develop support for protection and recovery.

* Any wolves or wolf carcasses handled during the course of the survey or otherwise obtained in Mexico should be sampled for genetic and serologic analysis according to established protocol.

BUDGET AND TIME SCHEDULE

Recommendations 1 - 6, (excluding dog and coyote blood samples):
Time = 17 Months

Material	Cost
Pick-up truck	$13,000
Gasoline and lubrication	2,400
Field equipment	1,500
Operation equipment	1,500
Salaries (two people, one year)	10,600
Fees (350 days, two people)	9,000
Horses rental	800
TOTAL	$38,800 U.S.

Dog and coyote blood samples - See Genetics Group Report

UNITED STATES

Long after wolves were considered eradicated from areas of New Mexico, Arizona and Texas along the international boundary, wolves continued to travel north out of Mexico, sometimes returning again to Mexico along the historical "wolf runways", sometimes surviving within the United States long enough to establish and use breeding dens (   ), and sometimes being killed in the United States. Confirmed captures and sightings from the late 1960s on, however, are few. Animals sighted may have been coyotes or wolf-dog hybrids bred for the pet trade.

Mexican wolf distribution reports complied for the December 1984 workbook of the Endangered Species Information (ESIS) (Ames, 1984) indicated Mexican wolf occurrences, many dating from the early 1980s for several counties in Arizona and New Mexico. The ESIS category of "present known occurrence" was used for sighting reports deemed credible because of the nature and location of the habitats involved, the frequency of reports at significant seasons, and the perceived experience of the reporter. Less credible but not improbable reports were grouped as "present possible occurrences". The first category (credible) included reports from Cochise, Pima and Santa Cruz counties in Arizona and Hidalgo County in New Mexico. The second category (less credible) included reports from Apache and Graham counties in Arizona and Catron and Luna counties in New Mexico.

The Ecological Services Field Office of the Fish and Wildlife Service in Albuquerque continues to receive, evaluate and, when warranted, investigate reports of sightings in New Mexico. Thus far, none of these most recent sightings have been confirmed. The Field Office should be contacted for more detailed information on this point.

RECOMMENDATIONS

* No Mexican wolves are known to remain in the wild within the United States. Expenditures for surveying these areas may, therefore, not be justified.

LITERATURE CITED

Ames, N.H. 1984. Endangered Species Information System, Species Workbook (Mexican Wolf), Part I, Species Distribution. U.S. Fish and Wildlife Service.

Hernandez, L., A. Lafon y S. Gallina. 1985. Distribution actual del lobe mexicano (Canis lupus baileyi, Nelson y Goldman). Reporte Primera Etapa. Instituto de Ecologia - SEDUE.

Leopold, A.S. 1972. Wildlife of Mexico: the game birds and mammals. Univ. of California Press.

McBride, R.T. 1980. The Mexican Wolf (*Canis lupus baileyi*): an historical review and observations on its status and distribution. U.S. Fish and Wildlife Service.

Mexican Wolf Recovery Team (MWRT). Minutes of meetings May 12-13, 1981; November 13-15, 1984.

Servin Martinez, Jorge I. 1986. Estudio para la recuperacion del lobo mexicano (*Canis lupus baileyi*) en el estado de Durango. II Etapa.

Proposal for a Protected Wild Population in Mexico

Proteccion de la Fauna Mexicana A.C.: Programma de Fauna Silvestre

Mexican Wolf Status in the Wild

Problem Description:

In the last 14 years, Julio Carrera had been claiming for an opportunity to demonstrate that is possible to try the last effort for preserve the Mexican Wolf in the wild, using different concepts, like the creation of a Reserve of large dimensions in the Sierra Madre Occidental of Mexico, or a program in accordance with the landowners for the total protection of this animals, paying for the losses, when they can be demonstrated, and at the same time conduce an education program about the wolf.

This program is the only real opportunity for the wolf, because until now, the efforts for reintroduce the wolf in the wild, had been unsuccessful, and by now, the programs for captive animals only can give the opportunity for maintain wolves for the zoos. The first step in this program is the research, that can give to us the real situation of wolves in the wild, trying to establish the places in where the animals live today.

Background - The wolves exist in Mexico in an original distribution in the Sierras Madres, in accordance with Leopold, in their book Fauna Silvestre de Mexico in the northern part of the country, but in the prehispanic age, the people who live in this parts don't leave a testimony for this animals only appears animals that had been interpreted like coyotes, the northern cultures in some cases in Zacatecas uses figures of animals that also are interpreted like coyotes.

When the Europeans come to the north of Mexico, some people write extensive descriptions of the wildlife, but the information about wolves is poor, but at the same time begin the development of activities as agriculture, mining and for the need of animal food after the wildlife they begin to raise cattle, is in this time when begin the conflict between wolves and men, and a large history of control, that continues until the recent years. In 1930, the wolf disappear of extensive areas, apparently for this time this animals had been extirpated from the Sierra Madre Oriental and only exist in Chihuahua, Sonora, Durango and Zacatecas.

In the 60, in this places the wolves were controlled using poisons mainly 1080, for the reason that they were an important vector for rabies, but really was a predation problem on the border with the United States and the pressure that the ranchers do for the control of this carnivores, this program not only affect the wolves population, also destroy the Mexican Grizzly and in large areas to the kitty fox, only the coyotes can survive to this campaign against the predators.

The last report about the status of the Mexican Wolf, is from Roy MacBride, who uses to work for the U.S. Fish and Wildlife Service, in 1980, he consider that in Mexico only exist in the states of Chihuahua and Durango, and probably in Sonora and Zacatecas, he considered a number of 50 pairs of animals for all the country.

Since this time we don't have other general report, a Mexican scientific from the Ecology Institute, Jorge Servin, conduce a research using wolf sounds records and he affirms to have responses, in the State of Durango, near to Santiago Papasquiaro in 1987. In 1985, Julio Carrera from the Antonio Narro University and Alberto Lafon form Chihuahua University, can identify a track, and a scat of wolf in the same area and they can listen wolf sounds.

In the same year a probable hybrid of wolf was killed in Chihuahua, and since this time Lafon have collected informs about a group of three wolves in Chihuahua in an area of the northwest of the state, in 1989, a female and the pups were killed in the same area.

Lucina Hernanadez, from the Institute of Ecology, consider sufficient evidences for the presence of wolves in Sonora near of the border with Chihuahua and Arizona.

The most recent reports for wolves come from a different area, the borders between San Luis Potosi and Zacatecas, Miguel Diaz Castorena, from the Government of Zacatecas, received a report of a group of wolves from the area of San Tiburcio in the northeast of Zacatecas, in 1988, and Eglantina Canales from Antonio Narro University, in 1989 received a report from a student and his father, who controlled wolves in the past of a group of three wolves in El Salado, San Luis Potosi, in the vicinity of the other report. Exist a lot of reports, for different parts of Chihuahua, Durango and Zacatecas, unfortunately, only a few can be considered as confirmable, because they can't recognize the animals, that in some cases are dogs.

Objectives:

1. Determine by evidences of sounds, scats, other signals and the visual contact with the animals, the existence of wild Mexican wolves in the Sierra Madre Occidental and the High Plateau.

2. Determine the principal nucleus of Mexican wolf population and the possible actual distribution of the specie.

3. In base of the collected information, present a plan for the recovery of wild Mexican wolf population.

Mythology:

The possibility of an encounter with a wolf now in Mexico, are very scarce, if we don't try to present a program that can permit recognize the possible areas where they exist now.
By now the highest possibilities are in Durango and Chihuahua, for this reason the main part of the work is going to be conducted at this states.

The brigade number one, in charge of Mr. Alberto Lafon, and Mr. Bernardo Balderrama from PROFAUNA Chihuahua, are going to develop a survey in the two states, collecting information about damages to the cattle, signals of the animals and historical range.

The field work is going to begin in the areas where McBride considered that exist the possible remanent populations, in Chihuahua are the zone of Casas Grandes in the northwest and Sierra del Nido, the area around Las Varas in the limits with Sonora is other important place, because the reports of the last times comes from the region. In Durango, the region of Tepehuanes and the mountainous region around Durango City. This part of the country requires special equipment because there are few roads and also have social problems.

The first step is to send questionnaires to the cattle man of both states requiring information, in the areas of interest, the people in charge need to visit the ranches or the landowner and interview to the people that is in charge of the operation. In that places where they consider as an credible report, begin the field work trying at the same time collect information of tracks, scats and other signals and conduct a travel using recorded voices, with the most possible quantity of stations in different parts of the ranches.

When they can found a positive response, the second part of the project begin, it consist in the preparation of stations where the animals can assist and the people in charge can take a photo, using an automatic one photo camera, triggered when the animal passes around the area that it covers.

With the information collected about wolves in this part of the country, we can begin to develop a plan for the conservation of Mexican wolf.

At the same time the brigade number two, with base in Saltillo, Coahuila, begin the same activities in the area of San Luis Potosi and Zacatecas, the first step is collect more information about the last reports, mainly with the goat shepherds and the landowners of the area and if exist a credible report begin the exploration with recorded voices.

This region is small that the Chihuahua-Durango, and can be explored in 90 days, in different seasons using a vehicle from Profauna, and partial time people.

The scheduling of the project, can be done when we establish the begin of the project.

Cost of the Project:

Brigade number one:

Material Cost

Pick-up truck------------------------$12,000
Gasoline and lubrication------------$1,500
Field equipment------------------------$850
Operation equipment------------------$700
Salaries (two people, one year)----$9,600
Fees (240 days, two people)-------$6,000
Horses rent-----------------------------$700
TOTAL-----------------$30,350

Brigade number two:

Material Cost

Gasoline and lubrication-------------$700
Field equipment-----------------------$500
Operation equipment-----------------$700
Fees (90 days, two people)--------$2,250
TOTAL------------------$4,150

TOTAL -----------------------------$34,500 U.S.

MEXICAN WOLF

Canis lupus baileyi

Population Viability Assessment

SECTION 5

CAPTIVE POPULATION

Mexican Wolf Captive Population

Recommendations and Goals

Current Mexican Wolf Population (Certified and Uncertified)

There are 40 (21.19) Mexican wolves in 6 U.S. and 3 Mexican institutions. In addition to the certified wolves there are several populations of uncertified wolves. One lineage of uncertified wolves is ASDM/GR (Arizona-Sonora Desert Museum/Ghost Ranch) lineage at five institutions consisting of 7.6. animals. Another uncertified lineage is the Aragon lineage consisting of 7.4 animals in two institutions in Mexico.

In the certified lineage there are 4 (3.1) founders. In the ASDM/GR lineage there are two (1.1) founders. In the Aragon lineage there two (1.1) founders.

The overall recommendation for the captive population is to preserve 90% of the original genetic diversity for 200 years. With the current certified founding stock of 3.1 this goal cannot be attained. In order to reach this goal all certified and uncertified Mexican wolves need to be genetically evaluated. All institutions will be responsible for the costs of securing samples for this evaluation. If the tested animals are determined to be of Mexican wolf lineage, they should be included in the captive management program.

It is estimated that 300 to 500 Mexican wolves are needed to achieve this goal.

Another potential source of founding stock are wild Mexican wolves. However, active recruitment from wild populations is not recommended at this time.

Carrying Capacity

Current captive carrying capacity in the U.S. is approximately 50 wolves; in Mexico it is approximately 35 wolves.

Carrying capacity for the Mexican wolf needs to be dramatically increased in order to reach the above stated goal. In order to achieve this goal, up to 65 additional enclosures are necessary. This number is based on an average of seven wolves per enclosure.

Currently all enclosures and Mexican wolf transfers must be approved by the USFWS in the United States and by SEDUE in Mexico.

1991 Breeding Season: A potential of eleven pairings of Mexican wolves for this year.
1991 Breeding Pairs:

United States

# 2 X #13	PDZA
#43 X #23	RGZP
#12 X #29	ASDM
#44 X #36	WCSRC
#47 X #35	WCSRC
#60 X #37	WCSRC
#66 X #74	WCSRC
#67 X #84	WCSRC
#61 X #73	FRWC

Mexico

#33 X #45	PZSJA
#34 X #28	SEDUE

1990 Transfers: All receiving institutions will pay freight costs.

MALE 29	(ASDM)	to	RGZP	
MALE 7	(ASDM)	to	PDZA (semen collection)	
MALE 8	(ASDM)	to	PDZA (semen collection)	
MALE 12	(RGZP)	to	ASDM	
FEMALE 73	(RGZP)	to	FRWC	
FEMALE 74	(RGZP)	to	WCSRC	
FEMALE 84	(RGZP)	to	WCSRC	
MALE 72	(RGZP)	to	BIZ	
MALE 76	(RGZP)	to	PZ	
MALE 77	(RGZP)	to	PZ	
MALE 78	(RGZP)	to	PZ	
MALE 60	(BIZ)	to	WCSRC	
MALE 61	(BIZ)	to	FRWC	
FEMALE 36	(LDSP)	to	WCSRC	
FEMALE 37	(LDSP)	to	WCSRC	
MALE 2	(WCSRC)	to	PDZA (semen collection)	
FEMALE 13	(WCSRC)	to	PDZA	
FEMALE 57	(WCSRC)	to	LDSP	
FEMALE 58	(WCSRC)	to	LDSP	
MALE 67	(WCSRC)	to	ZC	(if permits come through)

Semen Collection and Cryopreservation

Remaining founder #2 will be shipped to PDZA prior to breeding season. At PDZA he will be paired with #13, and will be collected throughout the breeding season. There are two F-1 males that can be collected (#7 and #8). These animals will be shipped to PDZA for semen collection and Cryopreservation and then returned to ASDM. The ASDM/GR lineage wolf #9113 is recommended for semen collection and cryopreservation.

Specific Recommendations

1. The Mexican Wolf Captive Management Committee in cooperation with the USFWS will immediately petition the AAZPA Canid Taxon Advisory Group (TAG) for inclusion of the Mexican wolf in the Species Survival Plan (SSP).

2. All non-certified Mexican wolves should be genetically sampled in order to determine their purity. This testing needs to occur within the next two months in order to include them in the 1991 breeding plan.

3. Within six months a meeting should be convened with representatives of the Mexican Wolf SSP Propagation Group, USFWS, and Mexican biologists and officials to draft a combined Mexican Wolf Recovery/SSP Master plan.

4. A program for semen collection and Cryopreservation should be immediately started. This is critical for the single remaining founder, and F-1 animals.

5. Three facilities with the potential of holding ten pairs each should be sought for special breeding. Funding sources for such enclosures should be explored immediately from USFWS, state agencies involved in re-introduction plans, holders of captive Mexican wolves, and private sources.

6. Recommendations should be made to the AAZPA by Canid TAG to make recommendations to AAZPA institutions holding "generic" wolves to replace them with Mexican wolves.

7. A mate for the lone Mexican Wolf at the Chapultepec Zoo be arranged.

8. A breeding and management strategy will be developed for the ASDM/GR lineage wolf. It is recommended that these animals remain in present facilities with no transfers until strategy is developed.

Mexican Wolf - Genetics of Captive population

Genetic Summary of Population

Descendant population mean kinship: 0.2898
Gene diversity: 0.8551
Founder Genome Equivalents: 3.4502

GENETIC SUMMARY	LIVING DESCENDANT POPULATION	POTENTIAL
Number of founders:	6	6
Mean retention:	0.817	0.817
Founder genomes surviving:	4.902	4.902
Founder Equivalents:	5.012	5.515
Founder Genome Equivalents:	3.495	4.902
Fraction of wild gene diversity retained:	0.857	0.898
Fraction of wild gene diversity lost:	0.143	0.102
Mean inbreeding coefficient:	0.247	

Founders:	T9100	T9101	5	T9000	11	2
Founder contributions	3.2500	9.7500	13.5000	4.6250	7.8750	6.0000
Fractional contributions	0.0722	0.2167	0.3000	0.1028	0.1750	0.1333
Number of living descendants	13	13	32	17	27	12

Fecundity & Mortality Report
MEXICAN GRAY WOLF Studbook

Restricted to: Cooperative Management: In Global Plan

Report End Date: 10 Oct 1990

Taxon Name: CANIS LUPUS BAILEYI

	Fecundity [Mx]...				Mortality [Qx]...			
Age Class	Male	N	Female	N	Male	N	Female	N
0- 1	0.000	30.3	0.000	25.4	0.370	43.7	0.460	41.7
1- 2	0.000	23.6	0.310	19.3	0.040	24.3	0.000	19.3
2- 3	0.000	20.2	0.280	18.0	0.050	20.9	0.060	18.0
3- 4	0.000	19.0	0.090	15.9	0.000	19.0	0.000	15.9
4- 5	0.410	18.5	0.370	14.8	0.000	18.5	0.070	15.0
5- 6	0.450	15.5	0.150	13.3	0.120	16.8	0.070	14.3
6- 7	0.510	11.7	1.400	8.9	0.080	12.4	0.110	9.4
7- 8	0.510	7.8	0.570	4.4	0.210	9.4	0.000	4.4
8- 9	0.890	6.7	0.000	3.0	0.140	7.0	0.000	3.0
9-10	0.650	5.4	1.120	1.8	0.000	5.4	0.000	1.8
10-11	0.400	5.0	1.000	1.0	0.000	5.0	0.000	1.0
11-12	0.500	5.0	1.500	1.0	0.000	5.0	0.000	1.0
12-13	1.090	2.3	1.500	1.0	0.310	3.3	0.000	1.0
13-14	0.000	0.8	0.000	1.0	0.000	0.8	0.000	1.0
14-15	0.000	0.0	0.000	1.0	0.000	0.0	0.000	1.0
15-16	0.000	0.0	0.000	1.0	0.000	0.0	0.000	1.0
16-17	0.000	0.0	0.000	1.0	0.000	0.0	0.000	1.0
17-18	0.000	0.0	0.000	0.8	0.000	0.0	1.000	1.0
18-19	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
19-20	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0

T = 7.787 T = 8.254 30 day mortality: 22%
Ro = 1.897 Ro = 3.366 (18 out of 83)

lambda=1.09 lambda=1.16

r = 0.082 r = 0.147

82 birth events to known age parents tabulated for Mx...

49 death events of known age tabulated for Qx...

WARNING: Values with small sample sizes (N) warrant less confidence...

Compiled by: P. Siminski / N. Ames / F. Swengel thru Captive Breeding Specialist Group, ISIS/SPARKS, 10 Oct 1990.

MEXICAN WOLF

Canis lupus baileyi

Population Viability Assessment

SECTION 6

DISEASE AND HEALTH

Disease Working Group Report (Lopez, Flores, Dernal, Kreeger)

Disease can be a significant mortality factor in free-ranging canids. A large financial investment is made in every animal raised in captivity and released into the wild. A large genetic value is placed on every wild wolf. It requires a relatively small investment of time and money to protect a wolf from disease.

The following suggestions are made for both free-ranging Mexican Wolves which may be caught in the course of a biological survey or a captive-raised animal released into the wild. A three-step process can be employed to help decrease mortality due to disease.

1. Disease Screening

Purpose: To determine the existing incidence of canid diseases in areas designated as Mexican Wolf habitat (i.e., habitat already occupied by wolves or habitat selected as a release site).

Method: Collect blood and fecal samples from trapped or shot coyotes, feral dogs, foxes, or wolves. Examine animal for ectoparasites (collect if found) or other pathologies. Take hair sample for potential toxicological screen.

Analyses: Rabies, parvovirus, coronavirus, canine hepatitis, distemper, leptospirosis, brucellosis, Lyme disease, endoparasites (including heartworm).

Action: If high incidence of communicable disease exists, consider removal of non-wolf carriers from area or oral vaccination program.

2. Animal Treatment - Pre-release treatment for captive-raised wolves to be released into the wild.

It will be difficult, given current technological limits, to keep a wolf parasite-free in the wild after release. If the wolf has been kept parasite-free in captivity, recommend a six-month pre-release program where the wolf is fed whole, natural prey (i.e., deer, rabbit, etc.) in order to induce parasite load. If debilitation occurs, treat animal but then continue with parasite exposure. Although not proven, it is thought that this technique may allow adaptation of wolf's physiology to adapt to parasitic relationship.

Vaccination protocol:

1. Rabies, killed, 3-year
2. Multivalent MLV: Distemper, parvovirus, hepatitis, leptospirosis, parainfluenza
3. Lyme Disease vaccine, if necessary

3. Animal Treatment - Treatment for wild-caught wolves or previously-released, captive-raised wolves

Adults:

1. Rabies, killed, 3-year
2. Multivalent DHLPP as above
3. Lyme Disease vaccine, if necessary
4. Ivermectin (despite no evidence that such will be beneficial)
5. Powder for ectoparasites

Pups (in endemic areas):

Vaccinate as above no earlier than 16 weeks (pups possibly vulnerable to infection before this period). Attempt to re-vaccinate pups 2-4 weeks later (locate den via radio-collared parents).

4. Epidemiological Control

1. Monitor wild wolf fecal examinations for parasite load. If increasing (#eggs/volume feces), consider oral ivermectin program.

2. In area of endemic rabies, consider oral rabies vaccination program.

MEXICAN WOLF

Canis lupus baileyi

Population Viability Assessment

SECTION 7

PUBLIC EDUCATION

Public Education Activities

The Mexican Wolf, as with many wolves, has traditionally been misinterpreted in both the United States and Mexico. Public education serves as our most effective tool to educate the people to the benefits and biology of the Mexican Wolf as it is associated with its preservation in captivity and in the wild. Since the goal of captive propagation of Mexican wolves is their eventual reintroduction to the wild, the reintroduction of captive wolves should be an underlying fact in Mexican wolf programs. The education strategies of the United States and Mexico are different and must be addressed separately.

In the United States the current goal for the Mexican Wolf has been outlined as an immediate need to continue and enhance the captive propagation of this sub-species. A need has been addressed for the increase in the size of the captive population. In order to do this, the public must be educated about why this sub-species of wolf should be managed in captivity

Several coalitions exist that are currently involved in education programs. These include New Mexico Coalition of Wolves, Preserve Arizona's Wolves (PAWs), and The Mexican Wolf Coalition of Texas. The Mexican Wolf Captive Management Committee (MWCMC) initiated the idea of producing a slide/video presentation on the Mexican Wolf. Carol Cochran Ph.D., Curator of Education of the Rio Grande Zoological Park was appointed by the MWCMC and approved by the US FWS to develop the program. Funding for development was supplied by USFWS. The presentation program is entitled "Call for Wild". There are two versions of this presentation, one for children ($65) and one for adults ($75). The children's version is accompanied by written material. These presentations are available for purchase or they may be checked out from institutions which the USFWS has supplied. There appears to be an inadequate supply of these presentation materials. The USFWS needs to prepare more copies of the presentation, at least 50 copies. Also these copies should be forwarded to interested institutions and appropriate state education personnel in Texas, Arizona, and New Mexico. Some copies of the presentation material are available, however the public education personnel, i.e. teachers, are unaware of its availability.

The Rio Grande Zoological Park, the Sonora Desert Museum and PAWs all utilize the USFWS program as well as other in house programs and lecture series. School groups utilize in house education at the zoos as well as Outreach Mexican Wolf programs initiated by the zoological facilities. A brochure specifically on Mexican Wolves was written originally by Norma Ames and was produced by the New Mexico Chapter of the Sierra Club. It is presently reproduced under the auspices of the New Mexico Mexican Wolf Coalition and PAWs.

The Mexican Wolf Coalition of Texas conducts public education at schools and adult groups, across the state of Texas, utilizing the US FWS presentation material. The organization has been involved in education through radio talk shows. Some lectures with live animals are carried out in Colorado, but this are about wolves in general.

Public education programs need to be directed at general public, zoo directors and staff, and special interest groups. The educators in the states of Arizona, New Mexico and Texas need to be made aware of the availability of presentation materials on the Mexican wolf and the validity of this program. In Arizona, Project Wild sends a newsletter to teachers, and this newsletter should be used to relate the Mexican wolf programs and presentation materials to the teachers. Zoos serve as a main point of public education and they should be utilized to direct specific material, such as the US FWS presentation, to the public in their educational programs. A public attitude survey was conducted in Arizona about wolves and it showed that the Arizona-Sonora Desert Museum in Tucson which conducts Mexican wolf education has had an impact on public perception. The zoo community should be made aware of the need for commitment to the Mexican wolf in both education and captive propagation. Educators at the university level, should be exposed to and made aware of the status of the Mexican wolf and how they can aid education by promoting this topic in their programs. The Audubon videotape on Mexican wolves presented on the Discovery Channel should be sought out as a source of presentation material.

In Mexico the goals for the Mexican wolf are to protect and manage the current wild population while enhancing the current captive management programs. The San Juan de Aragon Zoo and SEDUE conduct limited educational programs in Mexico city about the captive animals. However, this program has little effect on the education of people in the areas where Mexican wolves are thought to remain in the wild. These areas are in immediate need of education programs to aid the Mexican wolf efforts in Mexico. The audiences that education programs should directly impact are the ranchers, politicians, schools, local people and zoos. ProFauna, a Mexican fauna protection interest group in currently trying to educate teachers in these areas on how to educate their students about the Mexican wolf and other ecology programs.

The first need is to develop a mobile education unit in northern Mexico. This would cost between $20,000- $25,000. It would include one Mexican employee well versed in the area and the programs involving the Mexican wolf, a vehicle, and the material to present both education programs and workshops. The trained person would utilize action groups in Mexico that are currently conducting teacher education workshops. This would facilitate the distribution of the information. The education of teachers will be aided by conducting the education programs in the schools. Adult groups in the area need to be addressed with education programs. However, some of this must be done in a family to family method. One source of people meeting in these rural areas is during church or co-op meetings. Conservation education programs could be held following these meetings. The employee will directly contact ranchers and establish a working relationship to facilitate, both, learning ranchers feelings and educating the ranchers. Poster programs can be conducted by this person to augment the personal education programs.

A symposium should be planned in northern Mexico to bring together scientists, ranchers, local people, government officials and other people interested in the Mexican wolf to educate participants about the Mexican wolf while determining current feelings and problems with protecting and managing the wild Mexican wolf. During the symposium an attempt should be made to establish a Mexican Wolf Coalition of interested people in Mexico. This could serve as a source of funding and support.

Radio programming should be considered as a source of educating the rural public.

T-shirts should be developed in bilingual fashion to inform the public about the Mexican wolf. They should include a distribution map of the wolves' range. These should be distributed among the local people in the areas thought to be used by the Mexican wolves.

Some education materials have been produced in Spanish and are utilized in Mexico. Copies of these materials need to be acquired to understand what programs are being used in Mexico currently.

Major wildlife conservation organizations and federal funding sources such as WWF, Zoo Conservation Outreach Group, AID, and Sierra Madre should be approached for financial support of these projects.

ZOO CONSERVATION OUTREACH GROUP
Fossil Rim Foundation
Rout 1 Box 210
Glenrose, Texas 76043

NEW MEXICO MEXICAN WOLF COALITION
207 San Pedro N.E
Albuquerque, NM 87108

Public Affairs Officer
U.S. Fish and Wildlife Service
P.O. Box 1306
500 Gold Avenue S.W.
Albuquerque, NM 87102

Ft. Worth Ecological services
U.S. Fish and Wildlife Service
9A33 Fritz Lanham Bldg.
819 Taylor Street
Ft. Worth, Texas 76102

Texas Parks and Wildlife Department
Information Education
4200 Smith School Road
Austin, Tx 78744

The Mexican Wolf Coalition of Texas
P.O. Box 851224
Richardson, Tx 75085-1224

Arizona Game and Fish Department
Information and Education
P.O. Box 9099
Phoenix. Az 85068-9099

Agrupacion Sierra Madre
Insurgentes Sur 949-701
Col. Napoles
Mexico, D.F. 03810
Fax. 5438344 5439990

Proteccion de la Fauna Mexicana, A.C. (ProFauna)
Apdo. Postal 486   Centro
Saltillo, Coahuila
Mexico
Tel. (841) 4-49-97

MEXICAN WOLF

Canis lupus baileyi

Population Viability Assessment

SECTION 8

COMMENTS ON REINTRODUCTION

Reintroduction Comments

Question: Do the appropriate conditions exist to recommend reintroduction of captive-born Mexican wolves?

The following outline lists 10 necessary conditions, which should be met in order to recommend a reintroduction program. The position of the current population of Mexican wolves is evaluated with respect to each criterion.

1. Reintroduction of captive-born animals or translocation of wild animals should not be done if the reasons for the species' decline have not been identified and eliminated. This condition has not been met for the wolf, thus arguing against a reintroduction at this time (1990).

2. A reintroduction program is not warranted if there is insufficient protected habitat. Ideally the potential population size of an isolated population should be greater than about 75 animals 1 year or older. There is sufficient protected habitat potentially available for the Mexican wolf.

3. A reintroduction or translocation into an area already containing a viable population is not recommended. If, there is no genetic or demographic support for adding outside animals, additions may cause social disruption of the native population or introduce disease. It needs to be established throughout the range where there are available areas with small or no populations that can accept animals.

4. Evaluation of the available habitat and potential success of a program of reintroduction or translocation requires information about the behavioral ecology of the wild population.

5. A conservation education program is needed to inform and gain the support of the local populace and result for a reintroduction or translocation effort.

6. The reintroduction of animals currently in captivity (whether captive or wild born) is inappropriate unless the captive population is secure. This requires a long-term masterplan with goals for the species and the captive population as a part of the program for recovery of the species in the wild. The animals to be released should be surplus to the genetic and demographic requirements of the captive population as a part of this program. Released animals need to considered as no longer a part of the plans for the captive program (i.e. as not available for any further genetic or demographic contribution). This condition has not yet been met for the Mexican wolf.

7. Reintroductions or translocations are not recommended unless there is sufficient background information or knowledge about the methods and techniques of preparation, adaptation, and release that such an effort has some likelihood of success. Considerable

information and experience is available from the red wolf reintroduction project.

8. There need to be dedicated the resources necessary to monitor the activities and survivorship of the released animals.

9. A reintroduction or translocation is unnecessary unless the wild population needs re-establishment or augmentation in numbers or genetic diversity and the translocation or reintroduction will fulfill that need.

Recommendations:

A reintroduction or translocation program for the Mexican wolf needs careful evaluation to determine if these conditions can be better met.

Utilize the guidelines of the SSC Reintroduction Specialist Group for a more detailed analysis of the conditions that need to be considered to enhance the probability of success of a reintroduction program.

MEXICAN WOLF

Canis lupus baileyi

Population Viability Assessment

SECTION 9

PARTICIPANTS LIST AND MINUTES

Mexican Wolf Holding Facilities - addresses

U.S. - MWCMC

Bud Wiser
Alameda Park Zoo
1321 N. White Sands Blvd.
Alamagorda, NM 88310

Mark Rosacker
Living Desert State Park
Box 100
Carlsbad, NM 88221

Ken Kawata, Curator
Belle Isle Zoo
8450 W. Ten Mile Road
PO Box 39
Royal Oak, MI 48068-0039
313-267-7161 Phone
313-398-0505 Fax

MEXICO -

Dr. Laura Garza
(SEDUE) Secretaria de Desarollo Urbano y Ecologia
Rio Elba #20 Piso 8
Col. Cuauhtemoc, C.P. 06500
Mexico DF

MVZ. Gerado Lopez Islas
Parque Zoologico San Juan De Aragon
Loreto Favela s/n,
San Juan de Aragon
07920 Gustavo A. Madero, D.F.

F. Schoch, Director
Zoologico De Chapultepec
Bosque de Chapultepec
Mexico City 5DF, Mexico

Dave Parsons
USF&WSBox 1306

WOLVES PREVIOUSLY AT:

M.V.Z. Rene Hernandez Alvidrez
Jefe Area de Veterinaria
Centro Ecologico de Sonora
Apartado Postal #1497
Hermosillo, Sonora, Mexico

Alameda Park Zoo
Bud Wiser
511 Tenth Street
Alamagorda, NM 88301
505-437-8430

Phoenix Zoo
Reg Hoyt
PO Box 52191
Phoenix, AZ 85072
602-273-1341

MEXICAN WOLF ATTENDANTS:

Roland Smith
Point Defiance Zoo
5400 N. Pearl St.
Tacoma, WA 98407
206-535-5958 Phone
206-535-5958 Fax

Lee Ann Linam
TP&W
Resource Protection Division
4200 Smith School Road
Austin, TX 78744
412-448-4311 Phone

Ken Russell
USF&WS
Box 1306
Albuquerque, NM 87103
505-766-2983 Phone

Albuquerque, NM 87103
505-766-2983

Robert Wayne
Dept. of Biology UCLA
Los Angeles, CA 90024
213-825-9110 Phone
213-206-3987 Fax

Jim Jackson
Fossil Rim
Rt 1 Box 210
Glen Rose, TX 76043
817-897-2960 Phone
817-897-3785 Fax

Kent Newton
Rio Grande Zoo
903 Tenth St.
Albuquerque, NM 87102
505-842-7281 Fax

Carl Benz
USF&WS
2140 Eastman Ave. Ste 100
Ventura, CA 93003
805-644-1766 Phone

Bruce Williams
Fossil Rim
Rt 1 Box 210
Glen Rose, TX 76043
817-897-2960 Phone
817-897-3785 Fax

Loline Hathaway
Navajo Nation Zoo & Botanical Park
PO Box 308
Window Rock, AZ 86515
602-871-6573 Phone

Julio Carrero Lopez
Dept. Forestral
Saltillo, Buenavista
Coahuilla, Mexico
011-52-841-448997 Phone

Jane Pattie
Free Lance Writer/Photog.
PO Box 121623
Fort Worth, TX 76116
817-443-0342 Phone

Karen Sausman
The Living Desert
47-900 Portola
Palm Desert, CA
619-346-5694 Phone
619-568-9586 Fax

Terry Kreeger
University of Minnesota
Dept. of Ecology
Minneapolis, MN 55455
612-434-7361 Phone
612-432-2757 Fax

Reg Hoyt
Phoenix Zoo
PO Box 52191
Phoenix, AZ 85072
602-273-1341 Phone
602-273-1341 Fax

Gabriela Flores
Reproductive Science Lab
Texas A & M
College Station, TX 77843
409-845-4220 Phone
409-845-9369 Fax

Bill Foxworth
Reproductive Science Lab
Texas A & M
College Station, TX 77843
409-845-4220 Phone
409-845-9369 Fax

Jane Packard
Dept. Wildlife & Fisheries
Texas A&M

011-52-841-43110 Fax

Edward Spevak
Fossil Rim
Rt 1 Box 210
Glen Rose, TX 76043
817-897-2960 Phone
817-897-3785 Fax

Leslie Johnston
Henry Doorly Zoo
3701 S. 10th Street
Omaha, NE 68107
402-733-8401 Phone

Gerardo Lopez Islas
Zoologico Samuuam de Aragon
Mexico
5510030 Phone
3730039 Fax

Bud Wiser
511 Tenth Street
Alamagorda, NM 88301
505-437-8430 Phone

John Patton
LGL Ecological Genetics
1410 Cavitt
Bryan, TX 77801
409-775-2000 Phone
409-775-2002 Fax

College Station, TX 77843
409-845-5777 Phone

Ron McFarland
1988 Damascus Rd. Rt. 4
Golden, CO 80403
303-642-3353 Phone
303-642-0680 Fax

Vicki O'Toole
Wild Canid Survival & Research Center
PO Box 760
Eureka, MO 63025
314-938-6490 Phone

Peter Siminski
Arizona-Sonora Desert Museum
2021 N. Kinney Rd.
Tuscon, AZ 85743
619-883-1380 Phone
619-883-2500 Fax

Elizabeth Sizemore
The Mexican Wolf Coalition of Texas
PO Box 851224
Richardson, TX 75085
214-231-9229 Phone

Marcia Sullivan
Mexican Wolf Coalition of Texas
5815 Crooked Post
Spring, TX 77373
713-443-0012 Phone

Norma Ames
2509 Aladdin Road
Colville, WA 99114
509-732-4458 Phone

MEXICAN WOLF PVA

Canis lupis baileyi

October 22-24, 1990

Minutes

October 22, 1990:

Introductions

Population Biology

Seal - goals, overview

Seal - Small population biology

Kreeger - Vortex Population Simulation Program
Discussion about the use of this or any modeling programs.

Canid Genetics (Bob Wayne)

Areas of discussion:

1. Genetic distinction: type of markers
2. Genetic variability
3. Hybridization

Slides:

1. Canid phylogeny tree

2. Allozyme electrophoresis

3. Sampling locations of wolves and coyotes in North America

4. mtDNA polymorphism: evolutionary rate 5-10x nuclear DNA

5. coyote mtDNA genotypes (36 genotypes)

6. relation of genotypes and geographic relation: generally very little, i.e., little geographic partitioning, i.e. genotypically-related populations are not necessarily geographically close together

7. Fst - statistic for amount of genetic variation between localities; no significant differences between populations of coyotes
8. as sample increasing localities, see fewer coyote genotypes

9. What does this mean for wolves? Given high rates of gene flow in coyotes, might not expect to see differences among wolves, i.e., Minnesota wolves genetically similar to Alaskan wolves

10. In rest of world, wolf range is not contiguous, so that specific genetic types appear and become fixed (has not happened in northern NA). Can distinguish Italian wolves from Portuguese from Swedish, etc. Mexican wolves have genotype **not** found in other NA wolves. Therefore, Mexican wolf (MW) is genetically distinct. MW are 3-4 restriction site differences from northern NA wolves - about as much difference that exists in other Old World wolves from NA wolves. MW more like Old World wolves.

11. 15-year-old wolf samples from Texas had MW markers. From Smithsonian pelt samples; found that there might have been MW as far east as Louisiana at turn of century.

12. Sum: MW is genetically distinct; genotype was in TX and LA at turn of century; is related to other NA wolves

13. Allozyme variability; estimates of heterozygosity; MW = 0.11 which as high as out-bred wolf pops; less loss of heterozygosity as might expect; MW samples from captive animals

14. Hybridization; coyotes and gray wolves; mtDNA restriction fragment pattern: wolves from northern Minn, Canada had shared fragments with coyotes, some hybridization occurred between the two species. Most of the coyote genotypes are found in wolves from Minn, Ontario, and Quebec; **not** found in far north or western NA. At least 6 hybrid events have occurred and only with male wolf/female coyote crosses.

15. Threats to MW; hybridization with dogs or coyotes

Types of samples useful for genetic analyses: pelts, residual tissue on skulls, bones; fresh whole blood

John Patton

Patton's findings were basically summarized by Wayne. Has also used another genetic technique that suggests, again, that the MW is genetically distinct from other NA wolves. Ghost Ranch derived wolves and certified wolves both have similar data. Seal suggested that based on this preliminary data that the Ghost Ranch line be included with other MW as their inclusion will have a profound impact on founder representation, etc.

Genetic Working Group to be headed by Wayne and Patton; Wayne requested that fresh blood samples be obtained on all existing MW.

Captive Population Status

1) Status of certified wolves: Peter Siminski MW Studbook Keeper

6 wild caught 1971-1981 from Mexico (Chihuahua - 1.0 and Durango - 1.1) only 3 survived to produce offspring; one female was pregnant at time of capture (i.e., sire unknown); therefore, four effective founders; one male (#2) still surviving. This male may be related to founder female; this needs further study.

In 1985, USFWS in cooperation with holding institutions, formed committee to oversee breeding of wolves. Currently 6 U.S. and 3 Mexican institutions holding MW.

Seal suggested that due to age of surviving founder that semen be collected and frozen and upon its death to collect additional semen for freezing and tissues for genetic analyses. Also should collect the surviving original male offspring from #5 and wild male.

Current pop of MW = 40 (4 pairs in U.S.; 2 pr in Mexico). #5 female = approximately 40% founder representation; #2 = 20%; #11 = 25%.

Kent Newton: - Public opinion survey in Arizona, 62% favor of reintroduction of MW.

2) Status of Ghost Ranch/ASDM uncertified wolves:

Ron McFarland - 3 animals (2.1) from Ghost Ranch lineage.

Norma Ames - 1959 male caught in so. Arizona given to Arizona Sonoran Desert Museum (ASDM). In the next year, a female was obtained from Mexico; male died; son back-crossed to female; some wolves eventually given to Ghost Ranch (GR) and other institutions; genealogy of these early wolves kept; This ASDM-GR lineage was not certified for use in USFWS captive-breeding project because of uncertainty about the "purity" of the original male sire.

Loline Hathaway - have 5 wolves 1.1 from original Ghost Ranch lineage.

3) Status of captive wolves in Mexico:

Bill Foxworth/Gabriela Flores - survey of wolves in Mexican wolves. 1 in Mexico City; San Juan has certified and uncertified group; 1 in Monterey

Dr. Lopez - (San Juan) origin of wolves unknown, possibly MW; electrophoretic analyses compared these wolves found no differences between them and hybrid dogs. Have 9 animals which need additional genetic analyses and possibly certified as MW.

Wild Population Status

1) USA: Siminski - Arizona - unsubstantiated reports of wolves; most believable are from early 1970's; has hair sample from unknown canid taken 3 weeks ago; certain areas of Arizona produce continual reports of wolves, mostly mountain ranges which converge with Sierra Madre. No howling surveys conducted.

Norma Ames - in 1980's in Arizona, Animal Damage Control (USDA) took wolf reports seriously, no action taken however.

2) Mexico: Carrera - Wolf sightings in the last 5-6 years, primarily in Durango and Chihuahua. Univ. of Sonora found 6 wolves together two weeks ago at the border of Sonoran & Chihuahua.

He feels likely place to find wolves around Sonora/Chihuahua fairly close to U.S. Last year, tracks found by bear biologist in Sierra del Nido.

New group suspected in Zacatecas Mexico near populated areas; unlikely to have wolves but there are wild areas available.

Known wolves in Chihuahua and Durango. Private (illegal) bounty still exists on wolf. A danger exists in situations where wolf biologists employ local guides to help locate wolves. If evidence of wolves is found, local guide may try to harvest wolf for bounty. Incentive for rural people to harvest wolves. Ranchers claim livestock losses due to wolves; shoots wolf; other ranchers pay shooter for removing wolf. Or, if can't get wolf, ranchers hire trapper.

Success of any project to protect or reintroduce the wolf is to succeed, strong public education program must be implemented.

Kent Newton: Asked Dr. Carrera if the ranchers might not take more money to capture a wolf for captivity instead of shooting.

Jim Jackson: Suggested that Conservation Outreach Program should be instrumental in establishing an in-country conservation program to help insure the survival of Mexican wolves based on the success of the sea turtle program.

Ron McFarland: Felt that the concerns of the ranching community be addressed in any recovery plan for the MW. According to him, the current Rocky Mountain Wolf Recovery Plan does not protect the rancher. He feels that the Mexican Wolf Recovery Plan should include a statement that allows the removal (trapping, shooting) of wolves known to be killing livestock. ADC (USDA) should also respond within 24 hr to reported wolf kills; if they are unable to respond within this time period to affirm/deny wolf predation, then the rancher should automatically be awarded compensation. Compensation should be determined by a committee comprised of a rancher, wool-grower, livestock buyer, ADC, and 1-2 NGO representatives. McFarland states that in his experience ranchers are not opposed to wildlife, but want their right to control predators recognized in writing.

WORKING GROUPS:

1-Genetics: Wayne, Patton
2-Wild population: Carrera, Ames
3-Captive population: Siminski, Lopez
4-Model: Seal, Kreeger
5-Reintroduction: Smith, Carrera
6-Research:
7-Public Education: Foxworth, Flores

Tuesday, 23 October 1990

Reintroduction of the Red Wolf (Roland Smith)

History of red wolf; 40 wolves entered captive breeding program; 8 effective founders. 1984 became a SSP. 1987 first release into Alligator River. Total of 56 wolves now released. 131 wolves currently exist.

Smith stressed that a reintroduction program requires a lot of animals to insure success. Initial release had 76 wolves in captivity with 4 pairs considered excess for release. The goal of red wolf project is 300 in captivity and 250 in wild.

Combined SSP and USFWS Recovery Plan - important that both groups work closely to coordinated captive and reintroduction programs. Reintroduction is dynamic process. Continual movement from captivity into the wild back into captivity. (Seal commented that genetic variation must be maximized and sustained in captivity to use as a resource to maintain genetic variation in the wild population). There has been relatively good success in reintroducing family units. Release parents with 12-week-old pups; pups slow dispersal of adults. Smith stressed that good field technicians are critical to maintain contact and care of released wolves.

Problems: contact with humans; hit by cars.

Funding; Captive program = $175,000 not counting in-kind contribution from 18 zoos involved in breeding. Entire budget = $690,000.

Wild births: 4 litters since 1987; tend to be small (1-2 survive). Only 4 wild-born offspring currently known to exist.

In captivity, handling of wolves is aggressive so as to have negative reinforcement with humans.

Soft release: penned in release site for period of time; then pen opened to allow them to leave but food is still placed in pen. Also they are fed prey species. Dog vaccines used. Ivermectin given for heartworm before release and in bait once they are released. The initial animals released are not "important" animals - their offspring are the important animals forming the wild population. Acclimation period should be a minimum of 6 months to decrease dispersal tendencies.

Mexican Wolf Coalition of Texas (Elizabeth Sizemore)

USFWS Slide presentation on the Mexican Wolf

Wolf Disease (Terry Kreeger)

Based on wolf population at Isle Royal National Park
History of Isle Royal population
started with 3-4 animals
mid 50's about 20
50 wolves in 1980
crashed in 1980-81; now about 14 1989 captured 4 animals for disease study; found titers for parvovirus; probably transmitted by dogs illegally brought to island and/or on visitor's shoes. 3 of 4 animals had titers to Lyme disease--but tick has not been found on the island.
Wolves on Isle Royal are highly inbred

Should consider these and future reintroduced populations of wolves as 'captive' 'managed' populations. Need to manage disease to get the population to large enough numbers to be able withstand disease problems.

Seal: Organization of first set of 3 working groups: Genetic, Captive Population, and Wild Population

Working Group Sessions

Draft Reports from each Working Group:

GENETICS WG: Presented by Bob Wayne

Peter Siminski will attempt to locate the remains of the original Ghost Ranch male sire in order to obtain samples for genetic analyses by Wayne/Patton.

Permit for Mexican wolf samples crossing international border to be put on SEDUE's agenda for next meeting by Jose Bernal, DVM. Involve Jack Woody, Regional Director, USFWS. to prepare joint agreement for movement of samples across the border.
NOTE: need to discuss funding on Wednesday

NOTE: resolution of Aragon wolf lineage is high priority

NOTE: protocol needed for collection, transport and storage of samples

Russell requested that the genetic group prepare an incremental funding plan for the coming year.

Need to obtain samples from all certified and uncertified wolves for genetic testing. Seal suggested that a letter be sent to all wolf holders notifying them of meeting results and need for samples; P. Siminski will mail letter and genetic sampling protocol.

Ames/Seal suggested need to catalog historic samples to insure eventual sampling for genetic analyses.

Gabriela Flores volunteered to translate U.S. letters to be sent to Mexico.

WILD POPULATIONS: Presented by Norma Ames

Seal - need to develop an estimate of expenses of surveys; Carrera has project plans with a budget that will be submitted to group later.

Seal/Ames: Need to have protocol for dealing with any wolf which may be caught in Mexico, i.e., disposition, sampling, etc. Carrera stated that it will be highly unlikely that any wolf, alive or dead, will be brought to the attention of biologists or authorities.

Seal suggested that mapping of potential habitat be undertaken for future use.

Carrera stated that surveying wild wolves is very difficult due to terrain, etc. Also, techniques are limited due to environment.

Wayne asked that samples from any canid in wolf country be taken to determine if any Mexican wolf hybridization has occurred. Carrera said this would be possible. Wayne also suggested that dog samples could be tested for disease and the dog treated, if necessary. This would help protect any wild canids from disease.

Seal - recommended that the above recommendations for Mexico also be applied to U.S. Mexican wolf habitat areas whenever the opportunity exists.

Wayne suggested that semen be collected and frozen from any male released into the wild. R. Smith answered that any male released should actually be surplus, therefore well represented in the gene pool.

Ken Russell stated that there have been no positive signs of Mexican wolf in the southwest.

CAPTIVE POPULATIONS: Presented by P. Siminski
21.19 certified wolves; several pops of uncertified wolves (7.6 ASDM/GR; Aragon 7.4).

Kent Newton suggested that a joint agreement between U.S. and Mexico be undertaken so as to expedite the movement of animals and germplasm across the border to be used for captive breeding.

Siminski asked the Genetic Group- "Is the ASDM/GR animals can be certified as Mexican Wolf? Patton answered that not enough samples of ASDM/GR wolves have been analyzed to make unequivocal answer.

Additional Working Groups:

Public education: Foxworth, Flores
Reintroduction: Smith, Carrera
Modeling: Seal, Kreeger
Disease: Kreeger, Flores, Lopez

Seal - reviewed the operation of Vortex Population Simulation program and led the group through developing responses to each of the modeling questions for the wild population of Mexican wolves.

NOTE: use Alligator River Red Wolf data for Mexican wolf model for reintroduced population

September 24, 1990

Seal - Reviewed the variables he used for modeling the Mexican wolf population last evening. Based on wild population of 50 animals; age of first reproduction--2 and 3 years; also had losses due to disease and due to animals being killed once every 4 years. Ran simulations for 100 years. In general, the population loses genetic heterozygosity over time (based on 50 wolves, 100 iterations).

Working Group Sessions

REPORTS

Public Education: - Presented by Bill Foxworth

Jim Jackson suggested that the chairman of the CBSG contact the Discovery program to explore the possibility of a show on the Mexican wolf. Jackson also suggested that Seal contact T-shirt manufacturers to donate MW T-shirts to increase public awareness.

Seal suggested that all major conservation groups receive MW PVA documentation.

Seal asked P. Siminski to send him copy of Arizona public opinion survey.

Ken Russell to work out with P. Siminski a way to expedite the development of many more copies of the Mexican Wolf slide/video program.

Reintroduction: Presented by Roland Smith

Seal suggested definition of goals for reintroduction of the MW in its original range. That is, how many animals, single pop versus metapopulation. Seal suggested a minimum of 1,000 MW exist in the wild to constitute a viable population.

Jim Jackson stated that rationale for reintroduction based on conservation biology be firmly stated initially as opposed to any historical or legislative rationale.

Wayne asked for the justification for any arbitrary number given as a population goal. Seal answered that such numbers are based on the population size required to maintain genetic heterozygosity over an extended period of time. Other research has indicated that minimum effective population sizes for an "average" mammalian species is about 500 individuals.

Patton suggested that a large population (e.g., 2,000) be recommended due to the injection of lethal equivalents into the population due to hybridization. Thus, the larger the population, the less the effect of hybridization on the genetic "vigor" of the MW.

Kent Newton asked if this population goal is a "self sufficient" population, i.e., existing without external management. Seal answered that in the foreseeable future (50-100 yrs) this population will require active management.

Seal closed the discussions by thanking Fossil Rim for their hospitality.