MEXICAN WOLF RECOVERY PLAN

1982

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Prepared by the Mexican Wolf
Recovery Team

Team Leader:

Norma Ames, New Mexico Department of Game and Fish

Team Members:

Jose C. Treviño, Dirección General de la Fauna Silvestre
Larry Allen, Coronado National Forest, U.S. Forest Service
Dennis A. Meritt, Jr., Lincoln Park Zoological Gardens and
American Association of Zoological Parks and Aquariums
Gary Nunley, U.S. Fish and Wildlife Service
Dr. Ingeborg Poglayen, Arizona-Sonora Desert Museum

Team Consultants:

Curtis J. Carley, U.S. Fish and Wildlife Service
Dr. Aaron H. Long, Veterinarian, Winnie, Texas
Cynthia Pitsinger, Wild Canid Survival and Research Center
Greg Schmitt, New Mexico Department of Game and Fish

APPROVED

Robert A. Jantzen
Director
U.S. Fish and Wildlife Service

9/15/82
Date

Director General
Dirección General de la Fauna Silvestre

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Date

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This is the completed Mexican Wolf Recovery Plan. It has been approved by the U.S. Fish and Wildlife Service and Dirección General de la Fauna Silvestre. It does not necessarily represent official positions or approvals of cooperating agencies nor does it necessarily represent the views of all recovery team members who played the key role in preparing this plan. This plan is subject to modification as dictated by new findings and changes in species status and completion of tasks described in the plan. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints.

The Mexican Wolf Recovery Plan, dated September 15, 1982, was prepared by the U.S. Fish and Wildlife Service in cooperation with Dirección General de la Fauna Silvestre and the Mexican Wolf Recovery Team.

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U.S. Fish and Wildlife Service
Unit 1
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(303) 571-4656

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PART I. NARRATIVE

Preface

Recovery plan guidelines call for concise narratives. Ours is not concise. The team deems it necessary to record and convey certain information and theories about the Mexican wolf that are not in the scanty literature on this subspecies, but which may be pertinent to successful recovery of the subspecies. Also, reporting on the status of the recovery effort to date requires inclusion of the team's input on concerns relative to the captive propagation program.

In addition, this recovery plan makes more than the purely biological and ecological recommendations called for by the guidelines. Such recommendations may suffice for recovery of species unintentionally threatened by human activities. Socioeconomic actions, however, are also needed for survival or recovery of species that humans have deliberately sought to eliminate for socioeconomic reasons.

The plan is far from complete, lacking specifics and cost estimates for the later stages of the propagation and release projects. This omission is necessary at this time because the present slow progress in establishment of a captive breeding program pushes those later stages farther into an unseeable future. Later amendment of the plan is obviously required for its realistic completion. Beyond that, the team also recommends that the plan be periodically re-evaluated and amended in the light of progress of the recovery program and of new developments in knowledge of the Mexican wolf and in techniques of management and husbandry.

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Introduction

The Mexican gray wolf (*Canis lupus baileyi*) has been described as smallest in size of the American subspecies of *Canis lupus* (Goldman 1944). McBride (1980) notes, however, that *baileyi* skulls are frequently as large as, or larger than, those of some specimens of C. *l. lycaon*, and the average of weights he records for *baileyi* exceeds the averages recorded by Pimlott *et al.* (1969) for *lycaon*. Such size overlap might be predicted from the demonstrated clines (Nowak 1973) in which size increases from south to north and from east to west of the range of C. *lupus*. Size is one aspect --- an important aspect --- of the known variability and adaptability of C. *lupus*, which once ranged over much of the Northern Hemisphere. In North America, it occurred throughout most of what is now the United States and Canada, north to the Arctic Ocean, and southward through northern Mexico and the highlands and plateau of central Mexico.

For C. *lupus*, 32 subspecies or geographic races have been recognized for the world (Mech 1970), 24 of these for North America (Hall and Kelson 1959). Two of these, C. *l. baileyi* and C. *l. monstrabilis*, were recognized for Mexico.

Monstrabilis is now considered extinct (Mech 1970). In 1960, Baker and Villa stated that *monstrabilis* was probably extinct in Mexico except in western San Luis Potosí, basing their opinion on Dalquest's 1953 report of wolves in that area. No further reports of wolves have come from that region (Nowak 1974), and McBride, in his surveys starting in 1974, detected no wolves in the historic range of *monstrabilis* in Mexico. The historic range of *monstrabilis* also included western Texas and southeastern New Mexico, but the last record of *monstrabilis* from this area is that of a wolf taken in 1942 south of Marfa in Presidio County, Texas (Scudday 1972).

Of *baileyi*, fewer than 50 specimens may remain in the wild (McBride 1980) plus a handful in captivity. These southern subspecies are of special scientific interest because of possible adaptations, however subtle, to the environmental and ecological conditions at the extreme southern limits of the species' range. Now, only *baileyi* remains as a living specimen. Many persons today feel that there are many other reasons, besides scientific knowledge, to prevent extinction of life forms, even large predators, including continuation of maximum genetic diversity and the intrinsic right of all forms to exist.

Taxonomic and Geographic Purview of the Plan

Bogan and Mehlhop (1980) found "no convincing evidence to support the recognition of *monstrabilis* as a subspecies separate from *baileyi*." In addition, they state: "Wolves formerly assigned to C. *l. mogollonensis* and C. *l. monstrabilis* seem best referred to C. *l. baileyi*." *Mogollonensis*, like *monstrabilis*, is considered to be extinct (Mech 1970).

Historical reviewers who wrote of *baileyi*, *monstrabilis* and *mogollonensis* as separate subspecies recognized the adaptability and range expansions of *baileyi*. Scudday (1977) suggested that *baileyi* "was a late-comer to Texas,

probably moving in as C. *l. monstrabilis* was eliminated in the Trans-Pecos region." Gish (1977) thought that *baileyi* increasingly moved into Arizona from Mexico and southwestern New Mexico as other subspecies were eliminated in Arizona. These indications of *baileyi*'s adaptability and range expansions within southwestern United States support the biological possibility of reintroducing *baileyi* into those portions of the historic ranges of *monstrabilis* and *mogollonensis*, as well as of *baileyi* (Fig. 1), where suitable habitat may still remain. The Bogan and Mehlhop study would provide taxonomic justification for such reintroductions. Because suitable wolf release areas will be difficult to come by in southwestern North America, the team endorses adoption of the additional room provided by the Bogan and Mehlhop assessment. For that reason, information is provided below on the historic ranges of *monstrabilis* and *mogollonensis*, in addition to that of *baileyi*.

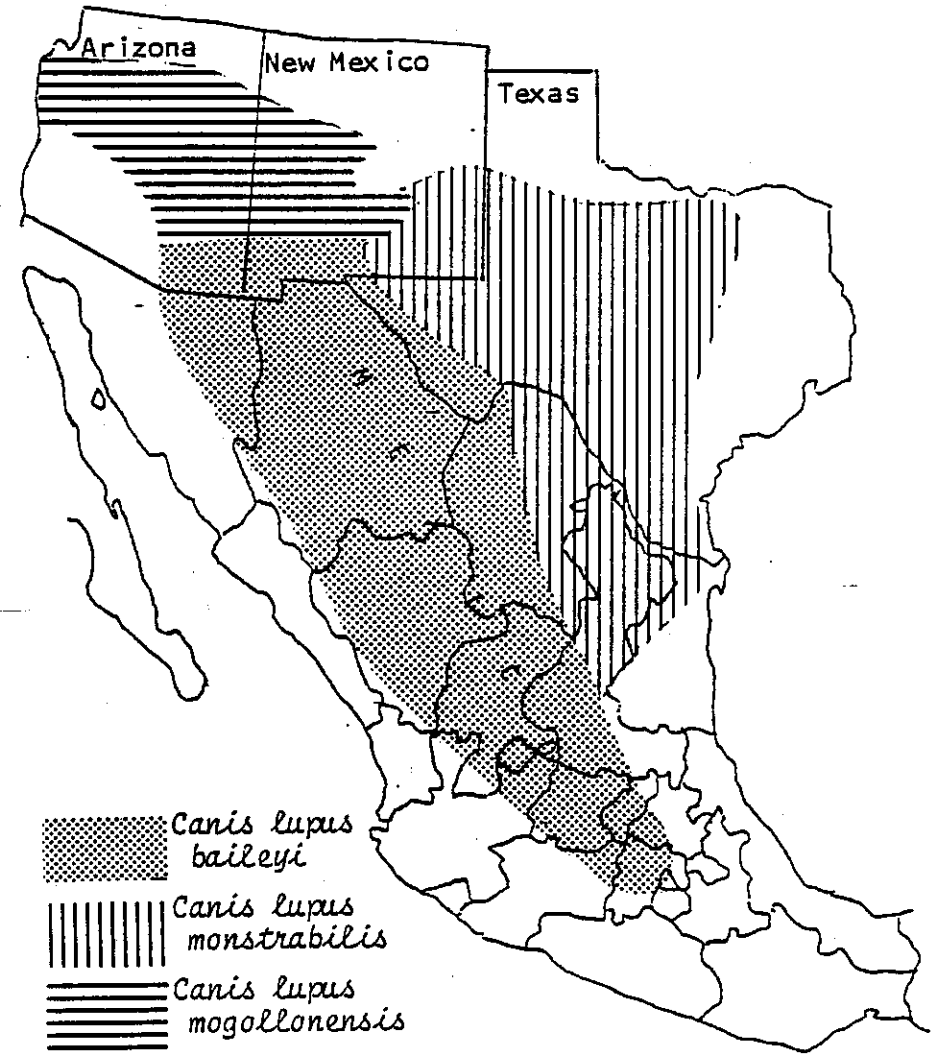

Figure 1. Historic ranges of C. *l. baileyi*, C. *l. monstrabilis* and C. *l. mogollonensis*. From Hall and Kelson, 1959, *Mammals of North America*.

Maximum Historic Range and Population Size

Hall and Kelson (1959), basing their work on Goldman (1944) and Dalquest (1953), depict the historic ranges of *baileyi*, *monstrabilis*, and *mogollonensis* as reproduced in Figure 1.

Goldman (1944) records the former range of *baileyi* as: "Sierra Madre and adjoining tableland region of western Mexico, formerly extending north to southeastern Arizona (Fort Bowie), southwestern New Mexico (Hatch), and western Texas (Fort Davis), south to the Valley of Mexico."

Goldman (1944) gives the following for the former range of *monstrabilis*: "formerly southern and most of western Texas (apparently replaced by *baileyi* in extreme western part), southeastern New Mexico, and south into northeastern Mexico (Matamoros)." For *mogollonensis*, Goldman (1944) states: "Formerly the Mogollon Plateau region, extending nearly across central Arizona, and east through the Mogollon Mountains of central western New Mexico."

For recovery efforts, estimates of maximum historic populations of the endangered species are of use in indicating densities that might be ecologically possible for a re-established population if habitat were still available. Reliable figures of this type are unavailable for southwestern and Mexican wolves, and habitat and prey-base needs of any reintroduced groups of wolves must be based on recent studies of such factors. Mech (1970) notes that wolf densities in North America range from one per 12 to one per 250 square kilometers, the density being broadly related to ungulate abundance. Mech (in Jorgensen *et al.* 1970) also stated that "average densities of one wolf for 50 to 100 square miles are not uncommon throughout most of the species' range," the highest average density, one wolf per ten square miles, having been reported for Isle Royale and Algonquin Provincial Park, Ontario.

The matter of historic population size is raised here, however, to point out the following considerations. Subsisting on native prey species, wolf populations were always limited by the position of the wolf at the narrow top of the food pyramid. Conceivably, wolf numbers could increase locally and regionally as wolves preyed less on scattered, wolf-wise wild prey species and more on the more easily available herds of vulnerable livestock. It is important, however, not to accept unquestioningly the accounts of the 1800s and early 1900s that speak of huge numbers of wolves ravaging herds of livestock and game. Recent historical researchers (Gish 1977, Nunley 1977) have compiled totals of wolves taken during periods of intensive governmental wolf-control programs. The total recorded take indicates a much sparser number of wolves in the treated areas than the complaints of damage state or signify, even when one remembers that these figures do not reflect the additional numbers of wolves taken by ranchers, bounty-seekers and other private individuals.

In reviewing old accounts of southwestern wolf numbers, it is also important to keep in mind that the wolf is a wanderer and far-forager. A pack or an individual may travel through many square miles. The statement that "wolves

were everywhere" could arise from the fact that one wolf or a few wolves were repeatedly seen at widely separated localities.

Even stockmen who complained of livestock losses to wolves sometimes recognized that their troubles were not caused by hordes of these predators. Scudday (1977) quotes from the observations of Judge O. W. Williams of life in western Texas in the late 1800s: "It is not that it [the wolf] causes any sudden, large loss [of livestock], but it is a constant, steady source of loss.... Yet these animals are not now and have never been numerous in our country.... Apparently in early times, nature did not allow for the wolf in the economy of this country [Pecos]. But when cattle were moved in...this condition was favorable to the appearance and increase of the lobo population." The realism of this relatively early assessment has important implications for the recovery effort.

Population Declines and Range Reductions - United States

Both popular and technical books about wolves contain millions of words about the history of human efforts to reduce wolf numbers or to eliminate wolves entirely for the purpose of decreasing loss of livestock to wolf predation. There seems no need to burden these pages with a lengthy account, and one is inclined merely to insert: "List of books available free on request; send self-addressed, stamped envelope."

It might, however, be informative to add that campaigns against wolves have a dimension beyond mere control to prevent livestock loss, the dimension of "fear and loathing," to use the words of Mitchell's (1976) title, "Fear and Loathing in Wolf Country." Actions taken against a predator that causes loss of dollars and food and that competes with man for wild prey inevitably take on the emotional overtones of a crusade. People far removed from the scene of action, who will never own a cow or meet a wolf, are taught to abhor and fear the malefactor, and to applaud its death and even its suffering. Thus, when the federal government in 1915 entered the anti-wolf campaign in the United States and added men and equipment to those already deployed by ranchers, the move had the general support of taxpayers for both practical and emotional reasons. By the time wolf numbers were so drastically reduced that the survivors often bore individual names, the need to blot out those few survivors certainly stemmed as much from emotional, as from economic, reasons. Any recovery effort must still deal with the residues of that emotion.

In the United States, the wolf control efforts of the Bureau of Biological Survey of the Department of Agriculture were, under governmental reorganization, later transferred to the U. S. Fish and Wildlife Service of the Department of the Interior (Young 1946). Government agents brought effective technology to bear against wolves: steel leg-hold traps, poisons placed in baits, and the poison cyanide administered via "coyote-getters." Other time-honored techniques also continued to be used: denning, arsenic baits, and of course shooting, even roping and killing, when an adroit and appropriately

equipped wolfer happened to meet a free wolf at close quarters. Removal of wolves was long stimulated by the offering of bounties by livestock associations, federal, state and local governments, as well as individual ranchers.

Factors other than antipredator programs also contributed to declines in wolf numbers at times. Gish (1977) records the effects of outbreaks of rabies and mange. Encroachment of human activities also caused loss of habitat, both to wolves and to their wild prey.

The records of wolves removed in antipredator efforts seldom identified kinds or subspecies of wolves. Wolves, in fact, were often lumped with coyotes in the records. Historical researchers, however, have been able to chronicle in more general terms the wolf reductions within the ranges of *baileyi, monstrabilis* and *mogollonensis*. For the ranges within the United States, Gish (1977) has done this for Arizona, Nunley (1977) for New Mexico, and Scudday (1977) for Texas. For all three states, they record a rapid reduction in wolf numbers from 1915 through the early 1920s. The situation for southwestern United States is summed up in Gish's (1977) statement about operations in Arizona: "By the mid-1920's, the once million-dollar losses of livestock to resident wolves had been shrunken to a hit-and-run tactic of a very few scattered individual predators."

The key word in the statement is now "resident." The annual predatory animal control reports of the various district agents then begin to follow a pattern. For several years they record no wolves taken and declare that there are no wolves left in the state involved. Then, the series is broken with a report of yet another wolf or two taken in the state. This pattern is repeated through the 1930s and 1940s and, for some areas, the 1950s, with reports of wolves becoming increasingly rare.

The reservoir from which the "new" wolves came was in Mexico. Following the same routes across the international border that wolves had used for as long as man had noted and recorded the movements, single wolves or small packs ranged north into the United States, eating available livestock and game en route and, usually, returned to their home ranges in Mexico. Some sought and found new home ranges within the United States, at least until traps, poison or guns eliminated them or drove them elsewhere. It could be that these were usually young, often male, wolves seeking unoccupied ranges after annual reproduction increased pack sizes, if only temporarily, within their original ranges in Mexico. Because wolves remained in larger numbers in Mexico, at least until quite recently, and because some traveled the old traditional runways into the United States, occasional wolves continued to be reported and sometimes taken in Texas, New Mexico and Arizona until almost the present date.

The last record for western Texas (Scudday 1972) is that of two *baileyi* taken in 1970: a male shot December 5 on Cathedral Mountain Ranch, 17 miles south of Alpine in Brewster County, and another male found dead December 28 in a trap on the Joe Neal Brown Ranch where Brewster, Pecos and Terrell counties meet.

For Arizona, too, the reports continue until almost the present date. Nowak

(1974) states that the Defenders of Wildlife organization knew of presence of two wolves in the early 1970s in the vicinity of its holdings in Aravaipa Canyon, Graham County. He also mentions recent reports of wolves in an area northeast of Tucson. Frank Appleton of the Research Ranch at Elgin told team leader Ames in March 1973 that there was an active wolf den north of the Research Ranch in the Empire Hills at that time. In fall of 1972, Ross Carpenter of the U. S. Fish and Wildlife Service identified as wolf-caused a calf-kill and canid tracks found on the Alvin Browning Ranch in the Galiuro Mountains near the Pinal-Graham county line (Nowak, pers. comm.). Chuck Ames of the Coronado National Forest reported seeing a wolf in December 1973 on the Santa Rita Experimental Range, Pinal County (Nowak, pers. comm.).

In New Mexico also, the Last Wolf on Record merges confusedly with the reports of "wolf" sightings that continue to the present day. Many of these reports come from persons whose experience in such matters lends credence to their reports but, without a specimen in hand, it is difficult to certify the sighting as one of *Canis lupus*, much less of *C. l. baileyi*. A "wolf" was sighted south of Cloverdale, Hidalgo County, June 16, 1976 (pers. comm. to N. Ames, as are all otherwise-uncited reports in this paragraph). This is along one of the old wolf runways. In 1971, George Pendleton shot a "wolf" on the Cloverdale Ranch (Nowak, pers. comm.); specimen unavailable. A wolf skeleton was found on the Diamond A Ranch, Hidalgo County, in 1970 (Nowak, pers. comm.); specimen unavailable. Arnold Bayne did trap a wolf on this ranch in 1965 (Nowak, pers. comm.); specimen confirmed. In 1973, a canid was shot on the L-7 Ranch east of the Caballo Mountains and south of Highway 52, Sierra County. In 1975, W. K. Barker of the Bureau of Land Management sent a photograph of the animal to N. Ames. The animal could be a wolf, but the specimen is no longer available. Through the 1970s, sightings of large, wolflike canids in the Gila National Forest continued to be reported to the U. S. Forest Service; again, no specimens. "Wolves" were sighted near La Ventana, Sandoval County, in October 1973; this would be easy to ignore if it were not for the relative frequency with which Ames receives reports of "wolf" sightings from the Jemez Mountains and areas just to the north of them, often from apparently knowledgeable persons. A wolf was reported traveling through the Manzano Mountains near Torreon, Sandoval County, on December 17, 1973. When combined with the report of the escape of a captive wolf in the Manzanos about the same time, this record sheds light on a possible source of the "wolf" reports: escaped captive wolves, plus wolf-dog hybrids, many of which have been raised in New Mexico, and quite likely in Texas, Arizona and Mexico.

The above reports have been included here to indicate that recovery efforts for the Mexican wolf should not dismiss out of hand the possibility that wolves may still occur within the southwestern United States. Even if surveys should not be deemed warranted to locate and protect any wolves surviving in these areas, surveys seem indicated for any areas into which wolves are to be released or would migrate to, if only to know possible sources of competition and hybridization.

Population Declines and Range Reductions - Mexico

Mexican wolves have survived longer in Mexico than in the United States simply because human settlement, livestock, and predator removal came later to north-central Mexico than they did to wolf ranges in southwestern United States. Within Mexico, even in pre-Columbian times, civilization claimed first the warmer, more easily cultivated lands that generally lie lower in latitude and altitude than the ranges of wolves in Mexico. In more recent times, however, cattle and other domestic livestock have been placed on the plateaus and highlands of north-central Mexico, and measures to control wolf numbers inevitably followed.

It was not until the 1930s and 1940s, however, that Mexican ranchers began to adopt the more effective wolf-control measures that were being used in the United States. When they did begin to use these traps and poisons, wolf numbers began to decline rapidly. In the 1950s, a program was initiated between the U. S. Fish and Wildlife Service and the Pan American Sanitary Bureau to train ranchers and veterinarians in the use of 1080 (McBride 1980; Leopold 1972). The program's avowed purpose was to control the spread of rabies (Nowak 1974). This disease had flared up in both cattle and wildlife north and south of the international border in 1945, spreading farther in 1946 and remaining widespread in subsequent years (Gish 1977). Baker and Villa (1960), however, point out that the cooperative program was initiated "at the repeated request of the livestock associations." McBride (1980) states that wolf control was applied in Durango and Zacatecas later than in Chihuahua and Sonora. Poison, traps and other antipredator techniques severely decimated wolf populations wherever wolves remained. The process was often hastened by disorderly and excessive applications of 1080 that affected populations of predators and other wildlife in many areas. Morales (1970) tells of one area where "*se han cubierto extensiones de más de 170,000 hectáreas con 8.5 toneladas de carne, inyectada con 300 gramos de 1080, siendo que para esa superficie únicamente se requiere de 21 estaciones formadas con 945 kilogramos de carne inyectados con 168 gramos de 1080*" --- in short, 8.5 tons of poisoned meat where even one ton would have achieved the same kill. This particular case occurred in Tamaulipas, but Morales indicates that uncontrolled application of 1080 was general in Mexico.

Present Status of Wolves in Mexico

Today, individual ranchers continue to use poison, including 1080, and also traps and denning to remove wolves, even though the wolf is protected by law in Mexico (McBride 1980). In addition, large, thinly settled landholdings continue to be broken up and redistributed to peasants. The tremendous, and growing, human population of these rural areas cuts trees for firewood, overgrazes the land with burros and horses, and uses wildlife for food, and the present agrarian system makes preserves for large mammals an unaffordable luxury (McBride 1980; Leopold 1972). McBride feels that "education, legislation, and/or law enforcement would have no effect in Mexico for the protection of wolves." Recovery team member José Treviño senses the start of a favorable change in attitudes toward wildlife, especially at higher political levels,

but only the future will tell the strength of the trend and the fruits it may bear.

McBride's 1978 estimate (1980 publication) of remaining wolf range in Mexico is shown in Figure 2. His estimates included: approximately 15 wolves in a large area southwest of Durango, Durango; approximately six wolves in an area north and west of Durango, Durango, and east of Tepehuanes; two adult wolves in an area north of Chihuahua, Chihuahua, and east of Casas Grandes, Chihuahua; and probably less than six wolves in the Sierra del Nido of Chihuahua southward through the mountains surrounding the Santa Clara Valley of Chihuahua; plus an unknown number in additional unchecked areas within the areas shown in Figure 2. He concludes today that "there is a high probability that less than 50 wolves may still inhabit Mexico." Inasmuch as these wolves prey on cattle and other livestock, their futures are uncertain. At the September 1980 meeting of the U.S.A.-Mexico Joint Committee on Wildlife Conservation, recovery team member José Treviño said he knew of perhaps

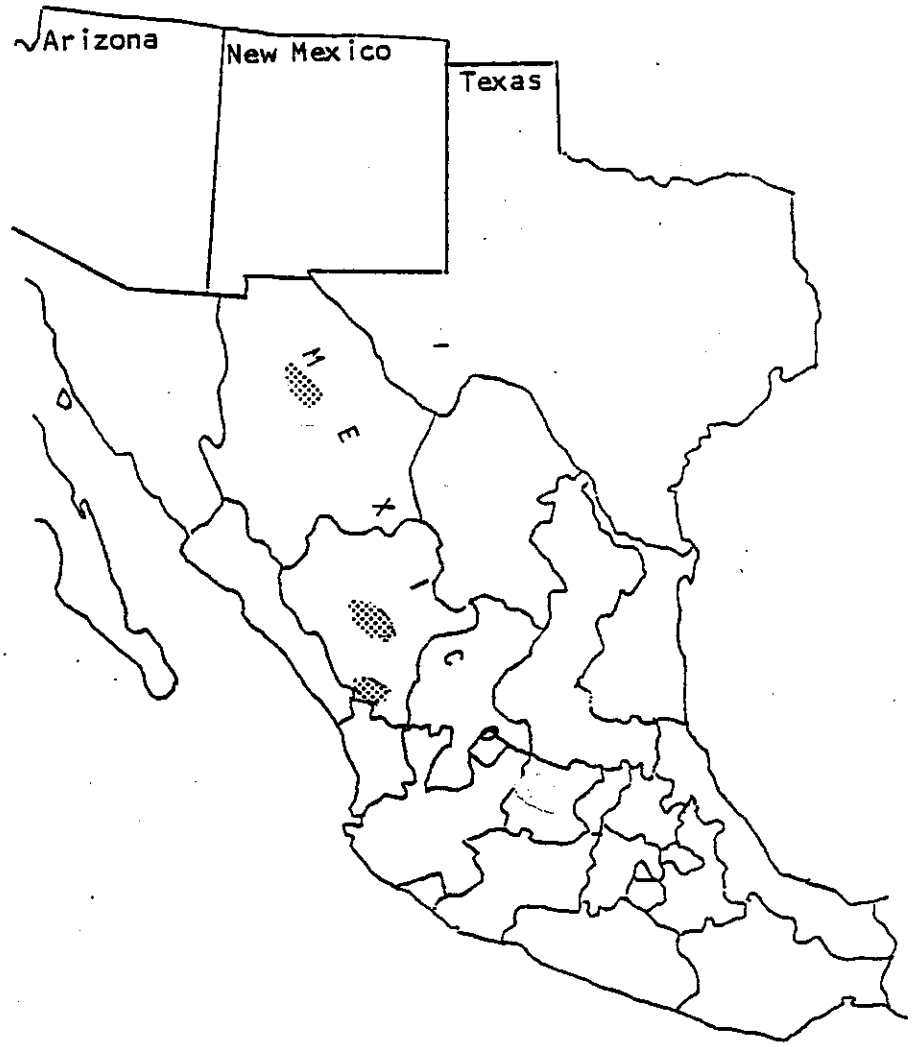

Figure 2. Approximate areas (shaded) in which McBride's 1976-1978 surveys confirmed presence of wolves.

as many as ten wolves in the wild in Mexico. In early 1981 Roy McBride investigated certain areas in northern Mexico that he thought offered the best chances for locating wolves for capture. He found none and came back to the United States discouraged about the prospects of finding more wolves (R. J. McBride, pers. comm.), although he planned to return to investigate other leads.

At the May 1981 meeting of the Mexican Wolf Recovery Team, José Treviño estimated that perhaps 30 wolves remained in the wild in Mexico and reviewed the most recent information he has gathered on the probable locations and sizes of the remaining groups. Treviño's summary indicates possible disappearance of wolves from some areas where McBride (1980) found indications of wolves' presence. It also indicates possible presence of wolves in some areas where wolves were not recorded by McBride. In the surveys, reports from ranchers are often the first clues to possible presence of wolves. Thus, few or no reports may come from an area characterized by lack of concern about or interest in wolves. This could account for the earlier lack of records.

The team therefore recommends that money be made available for additional intensive survey work and attempts to capture wolves located during the survey. The feeling is that this final attempt is a now-or-never effort and the expense is warranted. As the team in mid-1981 releases the plan draft for review, it is aware that it has recommended certain actions be funded and taken in fiscal years of the federal government for which budgets may already be firmly established. The process for review and acceptance of the plan would further delay putting an accepted plan into action. The recommended intensification of survey and capture work, however, must occur as soon as possible, and the team therefore forwarded a recommendation to this effect to the Regional Office of the U. S. Fish and Wildlife Service on May 27, 1981.

Legal Protection

Wolves are protected by law in all the areas within the historic ranges of the Mexican and southwestern subspecies. Dates of the protective legislation in the United States are: federal, May 1976; state, Arizona 1973, New Mexico May 1976, Texas 1977. In Mexico in the past, seasons have sometimes been closed on wolves year-round throughout the Republic (e. g., 1967-68). In other years, seasons were open in individual states, with no restrictions on the number of wolves taken, according to the perceived need for wolf control. For example, in recent years, seasons have been open as follows: in Chihuahua and Sonora year-round in 1961-62; in Chihuahua, Sonora, Jalisco and San Luis Potosí year-round in 1962-63; in Chihuahua and Zacatecas year-round in 1968-69, and the season was open May and June of 1971 in the entire Republic and in October and December of 1970 and January and March of 1971 in Chihuahua and Zacatecas. For 1971-72 and subsequent years, the U. S. Fish and Wildlife Service's listing of seasons in Mexico does not list the wolf and states that species not listed may be taken only under special permit from the Dirección General.

As the account in the preceding section indicates, law enforcement is least effective where the wolves remain in the wild today. Even within the United States, however, predator control directed against coyotes may endanger a wolf that may remain within or re-enter the United States. Governmental agencies responsible for predator control have restricted certain or all control measures in areas of the traditional wolf runways. The activities of private predator-takers, however, are not restricted in these areas.

Reproduction and Pack Structure

Although much has been published on the life history of *Canis lupus*, relatively little of the literature deals specifically with the Mexican subspecies, and some of that may have actually been derived by inference from what is known of northern subspecies. The available literature (e. g., Leopold 1972, McBride 1980) and records on captive animals (some of them summarized in Ames 1980) indicate reproduction of *baileyi* differs little, if at all, from that of other subspecies of *C. lupus*. They breed only once a year, and the normal gestation period is 63 days. Leopold says the Mexican wolf mates in late winter and whelps in March; McBride and Ames record mating in February and whelping in late April and May. Dens are usually ground burrows excavated in slopes where rocks will function to support the roof of the tunnel and burrow. The largest unborn litter recorded by McBride contained nine pups. Records of neonatal litters (e. g., McBride 1980, Ames 1980) show an average of 4 to 6 pups. Leopold's figure of litters of up to 14 is questionable. Various factors affect survival of neonatal pups, and the average one- to three-month litter is likely to contain four or five pups.

Both parents and other pack members, if present, will bring food to the young. McBride reports pups being on their own by October and traveling away from their parents by December. As indicated by McBride and elsewhere in this narrative, Mexican wolf packs may contain fewer individuals and be less cohesive in nature than is the case reported for northern subspecies of wolves.

Most authorities hold that wolves do not breed until their second year. Female Mexican wolves of the old ASDM-GR lineage for which good records are readily available (Ames 1980) bred for the first time, on the average, in their third year (second year - 1, third year - 3, fourth year - 1). Age of sexual maturity of sires of this lineage is obscured by the fact that these sires were either unpaired until over three years of age or paired only with same-age sisters. The one exception is a two-year-old male that sired a litter with his four-year-old dam. The availability of good nutrition under captive conditions has enabled female red wolves to breed successfully even as yearlings (C. J. Carley, pers. comm.), but it may be that most female Mexican wolves in the wild may not produce young until their third year. The red wolf captive breeding record augers well for proliferation in a captive propagation effort for Mexican wolves, but progeny of wolves released to the wild likely should not be counted on to reproduce until their second or third year.

Prey Species

No recent field studies are available on the normal prey of Mexican wolves in the wild. McBride (1980) tells of wolves' taking cattle, burros and horses, and refers to white-tailed and mule deer and antelope as natural prey. Bailey (1931) mentions only deer and cattle and says wolves prefer cattle. Leopold (1972) lists the following as natural prey of the Mexican wolf: deer, peccary, antelope, bighorn sheep, rabbits, many of the rodents, and occasionally some plant food such as berries and fruits.

Wolf Recovery Program Based on Captive Breeding

Among researchers and managers of wolves, there is a considerable body of opinion that a wolf release stands little chance of re-establishing wolves in the wild unless it is of wild-caught wolves, preferably a socially cohesive group, held only a very short time in captivity before release. The Mexican wolf recovery program apparently cannot follow this course of action. The wolves that remain in the wild in Mexico are extremely few; their existence is already jeopardized; their scarcity and separation may make unlikely any further reproduction in the wild, and suitable, approved, protected release areas are yet to be found. McBride (1980) saw no evidence of wolf hybridization in Mexico, but earlier authors (recorded in Gish, 1977) mention occurrences of wolf-dog hybrids along the Mexico-United States border. Dilution of the remaining Mexican wolf gene pool by hybridization is at least possible as wolves become fewer and more scattered. The male wolf captured for the program in March 1980 was taken when he visited the ranch where he had a dog mate and a hybrid litter.

For these reasons, this recovery effort must start by taking wild wolves into protective custody and trying to increase their numbers in a captive breeding program. At the September 1980 meeting of the U.S.A.-Mexico Joint Committee on Wildlife Conservation, representatives of Fauna Silvestre agreed to the wild capture of as many as possible of the remaining wild wolves, both for the protection of the wolves and for their use in propagation efforts. Accordingly, in this plan "restoration in the wild" can be taken to mean restoration by means of releases of wolves from the captive breeding program to the wild. Certain steps recommended in Section 2 of the step-down plan for the protection of any wolves remaining in the wild could in fact be discontinued if the Mexican wolf were declared extinct in the wild, but resumed under Section 3 when release proposals materialized.

To enhance the Mexican wolf recovery program's chances of success, the team feels that every effort should be made to minimize the undesirable conditioning that the inevitable long-term holding and breeding in captivity is likely to produce. Facilities should be located and designed so that the management of the captive wolves is as much as possible like a transplant from the wild to the wild, and management should proceed with minimal human contact. The team feels the expense is warranted to establish and man one or more holding-breeding enclosures in a remote, natural area within the historic range of *baileyi*, *monstrabilis* or *mogollonensis*.

The team would prefer to see Mexican wolves held and bred in such natural-area enclosures as opposed to zoological facilities in urban or similar situations with greater risks of disturbance of the wolves by human activities. This is no reflection on the expertise, character or interest of the personnel of such zoological facilities. Rather, it is a comment on the learning abilities of a sensitive, social animal that, once released, will be asked to succeed as a completely wild animal. It is a comment, too, on the wolf's ability to transmit some attitudes and experience from one generation to the next.

Although the team makes such recommendations, it recognizes that their acceptance will be affected by the general availability of funds and by prior allotment of funds to recovery work for endangered species that face problems easier and less costly to solve. The guidelines for management and husbandry of captive Mexican wolves (Appendix II) were drawn up in recognition of the fact that the Mexican wolf breeding program has already started, and will probably continue, to be conducted in existing zoological facilities. This in no way lessens the team's recommendation for establishment of facilities more conducive to attainment of the plan's primary objective.

At the September 1980 Joint Committee meeting, the representatives of Fauna Silvestre indicated their interest in moving trapped wolves into a large enclosure in Mexico. Subsequently, landowners in certain areas have expressed interest in use of their land for wolf enclosures. Similar offers have been made in two cases in southeastern Arizona. In both Mexico and the United States, realization of an enclosure would require formal governmental authorization plus assured funding for construction, maintenance, personnel, and food and likely veterinary services for wolves. It is possible that funding would be available from private organizations, foundations and individuals to supplement that which could be provided by governmental agencies.

Restoration in Wild Versus Preservation in Captivity

It has been suggested that extinction of the Mexican wolf might be prevented by propagation solely in captivity, without attempts to restore wild populations by means of releases. The idea is attractive because it avoids the tremendous socioeconomic problems that restoration in the wild entails. We must therefore comment on the suggestion.

Team member Dennis Merit:, Jr., is assistant director of the Lincoln Park Zoological Gardens in Chicago and chairman of the Wildlife Conservation and Management Committee of the American Association of Zoological Parks and Aquariums. As such, he is well qualified to speak for zoos in general. He has stated that "long range, I do not believe zoos will maintain Mexican Wolves, if the release to the wild or re-establishment in the wild concept fails. We certainly would not here and I know other major institutions have similar thoughts" (letter of March 20, 1981, to Ames). He later commented that under the species survival programs in zoos, priorities necessarily had to be

assigned to various species because of the lack of space and funds to accommodate all species in need of help. Because of the problems involved in wolf recovery, he felt few zoos would want to become deeply involved in wolf recovery programs.

If not established zoological institutions, then what about fenced enclosures similar to the proposed breeding enclosures in potential release areas for permanent holding of wolves? Fenced enclosures, however large, are not equivalent to the wild, but conceivably they might ultimately have to be accepted as the means of preventing extinction of the Mexican wolf. Such an enclosure might closely approach a natural situation if it is an ecologically complete unit that continues to produce prey animals and water adequate for wolf survival with relatively little management by humans. If constant management and provisioning are necessary to supply food for the wolves, the area is in effect only a zoological park.

As the enclosed wolf group increases its numbers, the need for human management of the enclosed situation will grow accordingly. Also, the number of separate groups of wolves so maintained must be adequate to preclude the possibility of eventual development of inbreeding depression, and records of breeding must be kept and coordinated toward that same end. The problems of over-all responsibility for financing and managing might be as knotty as those of restoring wolves to the wild.

If Fauna Silvestre and the U. S. Fish and Wildlife Service elect to maintain populations of Mexican wolves in large enclosures, rather than attempt to reintroduce wolves to the wild from the captive propagation program, the team is willing to formulate recommendations on husbandry and maintenance programs for such enclosures. At this writing, however, the recovery plan is written with the optimistic approach that recovery, even for a large predator, means recovery in the wild. We agree with statements made at a 1975 workshop on wolf reintroductions (Henshaw 1979) to the effect that use of large enclosures confuses the right of certain individual wolves to exist with the right of the species or subspecies to exist. Moreover, if the Mexican wolf is alive in captivity but declared extinct in the wild without a reintroduction attempt, there is thereby removed a major reason for the preservation of large areas of habitat as natural ecosystems. Recovery of the Mexican wolf in some part of the wild is valuable in that it ensures continuity, not only of the wolf, but also of a wilderness ecosystem with all its animal and plant components.

Holding-Breeding Enclosures in Release Areas

In preparation for wolf releases to the wild, the team recommends establishment of natural-area holding-breeding enclosures in areas ecologically suitable for releases of wolves, even though approval of releases in a particular area may not yet be obtained. The proposal is made with the thought that certain management steps for breeding enclosures so located may make it more likely that released wolves will not migrate from the release area.

Homing behavior has been reported for released wolves (Henshaw and Stephenson 1974) and for various other wild canids (see list of references in Danner and Fisher 1972). These and, to a certain extent, the transplant of *C. l. lycaon* to Michigan and the first red wolf release on Bulls Island, all indicate that a wolf that is put down in unfamiliar territory may prefer to head for or try to find his former location where he knew his way around, knew where the lunch bucket was, and perhaps knew where his friends were, regardless of whether that location was a home range or a home pen. It is conceivable that the following scenario of on-site breeding might help solve this problem for the Mexican wolf recovery program, which must start with wolves bred in captivity:

1. Build an enclosure in selected, approved release area;
2. Settle breeding pair in enclosure, providing with food and water;
3. When pups are produced and reach weaning age, begin to provide carcasses of native prey as food;
4. As pups mature, begin to provide live native prey;
5. Remove parent pair to another breeding enclosure elsewhere, and
6. When young are adept at killing native prey, open enclosure.

Management of this operation should proceed with minimal human contact once the pups are born.

The scenario aims, of course, at inducing the released wolves to accept the area as home range. It has been suggested that scent-marking the release area's perimeter with urine from wolves other than those of the release group might further deter released wolves from departing the release area. The necessarily large size of release areas, however, predicates an enormously long perimeter and, consequently, such large amounts of urine and walking that the idea is included here only to show the team did consider it. Peters (1979) found that wolves traveling habitual routes use a raised leg urination every 450 meters. Peters (in Henshaw 1979) indicated he found no evidence that wolves automatically find scent posts aversive.

Other Behavioral Factors Influencing Emigration from Release Areas

Released wolves may also depart the release area because of the wolf's natural tendency to wander through large areas in search of prey and because of normal population increase and dispersal. In Mexican wolves, however, these factors may have dimensions that make wandering a more serious consideration in recovery efforts for Mexican wolves than for more northerly subspecies.

First, Mexican wolves' tendency to range far may be related to the fact that the biomass of native prey species may have always been spread somewhat more thinly over the drier habitats of Mexico and southwestern United States than is the case for moister northern habitats. Secondly, we know little of what Mexican wolf pack structure might be in adequate habitat and free of persecution. This pack structure may differ somewhat from that of northern subspecies, again because of differences in kinds and concentrations of prey species, and again in ways that spread wolves more quickly over a larger area.

McBride has observed that Mexican wolves are found singly or in very small packs of two or three animals and never in the larger packs reported for wolf subspecies of Canada, Alaska and northern United States. Obviously, pack size, as a factor of survival, can vary with prey size, and these southerly wolves have had little need for large groups of cooperating hunters to bring down the relatively smaller ungulates of these southern latitudes. The recovery effort would perhaps be more wisely guided if we knew whether the lack of a *need for* large packs is accompanied by any genetic *predisposition against* formation of large packs. Such a predisposition would tend to hasten dispersal of reintroduced wolves --- especially after successful reproduction --- into new areas, possibly into human-wolf conflicts not likely in the original release area. A predisposition against formation of large packs could occur in wolves of desert habitats through its survival value for predators in areas of scanty prey base. Captive wolves maintained by team leader Ames are, according to Bogan and Mehlhop (1980), of southern subspecies, with greater than 99 percent probability, and their behavior may therefore be indicative of that of southern subspecies, including *baileyi*. They apparently tend to reject wolves that may come to be perceived as excess breeding-age individuals and, because fences prevent the departure of the rejected individuals, to attack these individuals repeatedly and try to kill them. The conflict, in other words, has not been solved by establishment of re-ordered dominance relationships and tolerance of the dominated individuals, as has happened in some groups of captive wolves. Admittedly, close confinement exacerbates these conflicts, but the conflicts also stem from social behavior originating in the animals' genetic makeup. If such intolerance is at all genetically based in these southern subspecies, casting out of excess individuals and resultant population dispersal might occur more rapidly in released groups of these subspecies than might be the case for northern subspecies with relatively stronger tendencies to form larger packs.

All this is conjecture at this point. The recovery effort should, however, keep in mind the possible existence of such behavioral patterns and their implications for habitat use of released wolves. If an area proposed for wolf releases does not have a natural or artificial barrier to wolf movement, the area should perhaps be surrounded by zones of decreasing legal protection.

Legal Protection for Released Wolves

The recovery effort should consider the use of flexible legal protective systems in order to enhance the acceptability of initial releases of wolves and of their continuing presence. One such system is the establishment of zones of varying degrees of protection, as applied to the eastern timber wolf, *Canis lupus lycaon*, in Minnesota. Briefly, this entails a central area of complete protection, surrounded by a zone in which certain wolves or restricted numbers of wolves may be taken under permit or license, either solely for specific depredation control or, in some areas, for reduction of wolf numbers.

In southwestern North America, mountain ranges of potential value to wolf recovery attempts are scattered units separated by areas of lower potential. It must be realized, therefore, that here we may not be speaking of one large central zone of complete protection, but of a fragmented group of zones of complete protection surrounded by one or more zones in which depredating wolves may be taken.

The other system of flexible legal protection would require amendment of the Endangered Species Act to provide for an experimental population classification, as opposed to a reintroduced population, as considered now under the Act. The proposed experimental population classification would entail prerelease cooperative agreements and regulations for the management of the released wolves. For releases in Mexico, governmental rulings to achieve similar ends are recommended.

Release Areas - Habitat Considerations

Gish (1977) described southwestern wolf country as including areas from the chaparral-desert scrub country, up through grasslands, and into the spruce-fir woodlands and noted that records are rare of wolves denning or establishing ranges in desert scrub below 3,000 feet. Leopold (1972) refers to former wolf habitat in Mexico as the temperate uplands. McBride (1980) says: "Today wolves inhabit elevations about 4,500 feet above sea level where higher rainfall has created better grazing conditions for wolf prey." For wolf recovery efforts, the nature of the habitat is significant in its potential for supporting suitable prey species, in existing use of the area for production of livestock and game, and, where potential conflicts exist, the extent to which compromises can be reached.

Several researchers have made predictions about the size of the area that a wolf pack would need for survival. At the 1975 workshop on wolf reintroductions (Henshaw 1979), Mech recommended a minimum area of 4,000 square miles, an area measuring 50 by 75 to 100 miles or about 40 miles in radius, for "establishing a reasonably viable, well-functioning, well-organized natural population of wolves which would interfere with man minimally."

The release area must be capable of producing a continuing supply of prey animals adequate to support the desired number of wolves. Fuller and Keith (1980) found the food requirements of the rather large wolves of northeastern Alberta to range from 0.12 to 0.15 kg prey/kg wolf/day. Mech (1970) found that the Isle Royale wolves consumed an average of about .17 pound of moose per pound of wolf per day in winter. He noted that this was two to four times the maintenance requirements that had been derived from studies of captive wolves. His thoughts on the fate of the extra calories indicate that the prey base should likely not be skimpy in re-establishment efforts: (1) wild wolves might spend more energy than was thought; (2) the wolves might be accumulating fat against possible hard times, and (3) digestion might be less efficient at high rates of food intake. The extra intake would also ensure a more adequate supply of nutrients, such as vitamins and minerals, that are often present in minute amounts.

Wolves in warmer climates likely need somewhat fewer calories. Computations of prey biomass needed to support released Mexican wolves, however, would have to figure in percentages "wasted" by wolves or "lost" to scavengers. Records are many (e. g., Mech 1970) of northern wolves' thriftiness, of their staying with a kill unless disturbed and consuming it almost completely. Mexican wolves of recent decades have learned to eat one good meal from the yearling cattle killed, then depart to save their own skins. This recovery program may be lucky in its inability simply to trap and transplant Mexican wolves; the natural-area breeding-release scenario proposed may aid in reinstating a regime of thrify consumption of native prey. As for use of wolves' kills by scavengers, quite likely coyotes are already present in most areas where releases of Mexican wolves might be considered. Scavenging of wolf kills by coyotes is therefore possible. It would remain to be seen whether the wolves would establish themselves in a territory and kill and drive off coyotes as has been recorded for northern wolves (Fuller and Keith 1981, Mech 1970, Seton 1929, Stenlund 1955, Young 1944).

In evaluating possible wolf release areas in Mexico and the southwestern United States, we must also remember that the ranges of this area, being relatively drier, support less prey food per square mile than do the moister northern habitats involved in the studies mentioned above. Moose must be translated into the smaller ungulates available here, and the availability of smaller prey that wolves would eat must also be considered. All this may mean the expenditure of more hunting energy per pound of food obtained because the units of prey are smaller and more scattered.

Despite the drier climate of southwestern North America, free water is available in the historic and present range of the Mexican wolf, and adequate amounts of free water must be accessible in any proposed release area, for both the wolf and its prey. Mech (1970) feels that wolves require considerable amounts of water, especially after gorging, and estimates a need of nearly two quarts a day for a 70- to 80-pound wolf. Team member Dr. Poglayen raised the question of whether wolves of more arid regions might be physiologically adapted to function with less water intake or with longer periods of water deprivation. The following observations indicate they are not. Team leader Ames provides water for captive southern wolves in 70-gallon hog waterers plus water in small pools. In winter, the latter freeze solid, becoming unavailable for drinking water, but small electric heaters prevent freezing of the water in the hog waterers. Evaporation is minimal because the waterers are covered. The frequency and amounts of water refills in winter, plus the numbers and sizes of wolves serviced allows for a rough estimate of daily water use per wolf and it proves to be very close to Mech's figure. More recently, Dr. Poglayen measured daily water use of a captive female southern wolf at the Arizona-Sonora Desert Museum, noting amounts used daily from the wolf's supply pail and allowing for evaporation indicated by a control pail placed in an adjoining, unoccupied pen. Daytime temperatures during the ten-day period ranged from 96°F to 108°F. The wolf used a mean of 2,069 cc (2.19 quart) daily, and daily water intake ranged from 1,480 cc to 3,000 cc (1.56 to 3.17 quart).

A suitable release area would also include "broken sloping country suitable for hiding dens, plus timber and brush for cover" (McBride 1980).

Regardless of which wild prey species were eaten by Mexican wolves in the past, the recent diet of the remaining wild wolves of these southern subspecies has been livestock, primarily yearling cattle (McBride 1980). Even if the recovery effort teaches wolves that are candidates for release to enjoy a diet of native wild prey species, the wolf's ability to take cattle and its normal predilection to choose whatever prey is easiest to take must be borne in mind in the choice and management of release areas. Areas to be considered for initial releases of wolves should be, first, those with little or no existing use for livestock grazing and, secondly, those whose livestock allotments could be most easily and economically bought out or otherwise eliminated.

Particularly within the United States, big-game hunting has been a traditional use of habitat that might be considered ecologically suitable for releases of wolves. The recovery effort will have to address possible conflicts with the big-game hunting constituency. Educational efforts to promote understanding of, and sympathy for, wolves may lead to greater acceptance, by both hunters and the general public, of the idea of sharing the use of remaining habitat to prevent the extinction of these wolves. Possibly, also, the recovery effort should include the concept that re-establishment of adequate numbers of wolves might eventually warrant some controlled taking for sport and pelts. Part of the impetus for the early conservation movement came from game protective associations that wanted to prevent extinction of the sources of sport hunting and desirable meat and hides. Some today may also view the opportunity to take wolves and their pelts as a desirable product of appropriate management of the wildlife habitat and, taking this view, they may more readily accept re-establishment of wolves.

At present, deer numbers throughout much of southwestern United States are relatively low. This fact will undoubtedly cause more big-game hunters to oppose wolf releases than would be the case if deer were now as abundant here as they were in the 1950s and 1960s. Habitat management activities to benefit large ungulates are under way in the Southwest, however, and may be effective in increasing deer numbers. Some of these activities benefit other forms of wildlife as well. Agencies that manage lands and wildlife continue to provide waterings by well-drilling, development of springs, and provision of water impoundments and catchments. Vegetation is managed, where possible, to correct past damages of overgrazing and of reduction of habitat diversity and to improve the vigor and availability of forage plants. Techniques to manipulate vegetative cover include managed wildfires, prescribed burning, removal of undesired brush and harvests of mature trees, and seeding and planting of desired vegetation. These and other habitat-manipulation techniques should benefit deer populations and, thereby, also benefit released wolf groups.

Wolf releases should be considered only for large tracts of public lands. In the Rocky Mountains, public lands today face the possibility of major ecological changes for the sake of extraction of oil, gas and strategic minerals and resultant increase in human population. This factor may further limit the choice of areas suitable for releases of wolves, both in Mexico and the United States.

Robinson (in Henshaw 1979) has pointed out that experiences in Ontario and Minnesota indicate that wolves stand little chance of re-establishment in areas of high or moderate human population. He says that "somewhere between six and twelve persons per square mile is a critical threshold." Almost any area that might be considered as a release area in Mexico or the Southwest would meet this criterion.

Regulatory and policy mechanisms exist, at least within the United States, that would preclude releases of predators where they might jeopardize endangered prey species. The mobility of wolves, however, requires that extra attention be given, in selection of release areas, to the matter of possible impacts of wolf releases on any endangered prey species that might exist in a proposed release area.

Given uncertainties that exist now (January 1982) about the rate of progress of the captive propagation project, proposals for consideration of specific release areas are not included in the present issue of the plan, which covers the period only to September 30, 1984. A search for possible sites and preliminary consideration of them will begin in the near future, however, and estimated costs have been included in the implementation schedule for FY84 to advance procedures called for in Steps 322, 323, and 324, as far as is likely possible up to September 30, 1984.

In dealing with matters of habitat for wolf reintroductions, the step-down plan does not specify measures to follow in Mexico as opposed to those for use in the United States. The recommendations apply to both areas although, obviously, the regulatory and management mechanisms available for any one operation may differ from country to country. It should be noted, however, that the wolves now in the breeding program for which the U. S. Fish and Wildlife Service is responsible are considered property of Mexico and that the federal wildlife agencies of both countries have agreed to give areas within Mexico priority in reintroduction proposals. Leopold (1972) proposed "setting aside a great national park or wilderness preserve in the northern Sierra Madre Occidental" as "one of the best ways of maintaining at least a fragment of the shrinking population" of Mexican wolves. McBride's study (1980) indicates it may be unrealistic to expect creation of such a preserve in the near future. The comments of José Treviño, referred to above, promise hope for the future. The idea of a preserve and of a breeding-release enclosure in Mexico will be a goal of the recovery program.

In a sense, any proposal to reintroduce Mexican wolves in the United States would depend on availability of wolves from the breeding program after the priority of restoration in Mexico is met. Nonetheless, progress of the captive breeding program is likely to be such that there will be enough wolves available for release in both Mexico and the United States by the time either country has completed all steps necessary to obtaining a suitable, approved release area. For steps 322, 323, and 324, therefore, the present implementation schedule names "states and agencies involved" as cooperators in the action, and the intent is to include those within the United States. At this writing, exact agencies cannot be named because location of areas to be proposed as release sites is not yet known. Within the United States, however,

these agencies may include, among others, any of the following:

The following agencies' regional and state offices administering lands in New Mexico, Arizona or Texas: U. S. Forest Service, U. S. Bureau of Land Management, National Park Service;
New Mexico Department of Game and Fish;
Arizona Department of Game and Fish;
Texas Parks and Wildlife Department.

Each of these agencies should be contacted for agency review and approval of the plan, with the understanding that no wolves will be released on lands controlled by the particular agency or in areas where the agency's approval is mandated until such time as any required procedures, such as environmental impact statements and public hearings, have been satisfactorily completed and the agency's approval for the specific release is granted.

Recovery Actions Already Taken

McBride's 1980 publication summarizes knowledge about the natural and political history of the Mexican wolf in Mexico. McBride has surveyed most of the areas in Mexico where wolves are likely to be found, and his 1980 publication describes the survey methods on page 12. McBride and José Treviño are continuing their attempts to locate and inventory wolves in Mexico and to obtain additional wolves for the captive breeding program. As indicated above, the team has recommended an intensified survey and capture effort for the near future.

Attempts to capture wolves in Mexico started in 1977 under agreements concluded between the governments of United States and Mexico and under permits issued by Fauna Silvestre. Several wolves were captured, and the survivors and offspring are being held at cooperating facilities that have signed agreements with the U. S. Fish and Wildlife Service for the holding and breeding of wolves in the program. At this date, those facilities are the Arizona-Sonora Desert Museum near Tucson, Arizona, the Wild Canid Survival and Research Center near St. Louis, Missouri, and the Rio Grande Zoological Park at Albuquerque, New Mexico (agreements signed July 1979, October 1979, and November 1981, respectively). At the September 1980 meeting of the U.S.A.-Mexico Joint Committee on Wildlife Conservation, representatives agreed to the location and capture of as many of the remaining wild wolves as possible.

Dr. Ingeborg Poglayen, recovery team member and birds and mammals curator at the Arizona-Sonora Desert Museum, has been appointed studbook keeper for the Mexican wolf, and she will coordinate all identification numbers and maintain their records under the ISIS system.

The National Fish and Wildlife Laboratory, U. S. Fish and Wildlife Service, under contract signed with the New Mexico Department of Game and Fish, has concluded a taxonomic re-assessment of *Canis lupus* in southwestern North America (Bogan and Mehlhop 1980). The authors analyzed historic and recent specimens from Mexico and southwestern United States and recommended referring the subspecies *monstrabilis* and *mogollonensis* to *baileyi*. The recommendation's implications to the recovery effort have been mentioned above under "Taxonomic and Geographic Purview of the Plan." The study also confirmed that recent specimens "show close affinities with *C. l. baileyi*."

In addition, Bogan and Mehlhop analyzed the taxonomic affinities of wolves of other captive lineages: the old Arizona-Sonora Desert Museum lineage, descendants of which are held in several localities, and the Wild Canid Survival and Research Center lineage now at St. Louis. The report's abstract states: "Captives, although closest to *baileyi*, show tendencies toward dogs, but whether these result from dog genes or from the effects of captivity is unknown." These lineages had been discussed at the Mexican Wolf Workshop held in February 1979, and "the FWS suggested that for the time being, captive propagation efforts use only stock captured from the wild in Mexico beginning with the seven animals captured by Mr. McBride" (Woody 1979). On May 22, 1981, the Regional Office of the Fish and Wildlife Service clearly expressed its decision not to use any wolves of the older lineages in the recovery effort (letter included in Appendix 1).

The following step-down plan provides for evaluation of the taxonomic affinities of other wolves located and possibly of Mexican or southwestern subspecies. It provides for consideration of use of such wolves in the recovery program, provided they prove to be taxonomically acceptable, and if the existing capture and breeding program should prove unable to produce wolves for release. To guard further against entry of unsuitable wolves into the recovery program, the team adopted the following definition and stipulates that it applies to all procedures in the step-down plan:

> For recovery program purposes, a Mexican gray wolf is a wolf of known Mexican origin, i. e., taken within the historical range of *C. l. baileyi* or of a lineage originating from wolves taken within such historic range, and having no known or identifiable hybridization. Any other wolves must be excluded from breeding and release programs specified within the context of this recovery plan.

In early 1981, the low numbers of wolves in the captive breeding program and their interrelatedness, plus the diminishing prospects of obtaining more wolves from the wild, raised the question of whether the genetic base of the program was adequate to avoid possible inbreeding degeneration. The paper prepared is appended (Appendix 1), along with subsequent decisions and comments.

Frozen Semen and Artificial Insemination

Until May 20, 1981, the captive breeding program included only one female (AF005). Prior to 1981, she had not bred in captivity, and the question arose as to whether artificial insemination should be used. The female produced pups naturally in 1981. The team's earlier input on the question is recorded here largely as history, but also as an indication of the team's recommendation in the event catastrophes in the breeding program again made AF005 the sole "hope":

> Using frozen semen, Dr. Stephen W. J. Seager and his colleagues have produced successful pregnancies in the dog (Platz and Seager

1977) and the wolf (Seager *et al.* 1975). Although the procedure has been suggested for use in the Mexican wolf propagation effort, at the time of this writing there is no majority opinion favorable to the suggestion among the team nor in the U. S. Fish and Wildlife Service or in the Dirección General de la Fauna Silvestre. There is now only one breeding-age female in the project, she is now in 1981 nine years old. We hesitate to incur any risk to her through procedures such as artificial insemination or ovum removal for storage of ova, and we hesitate to risk loss of a breeding season if there is any chance at all that she might reproduce naturally. Nonetheless, collection and preservation of sperm from male wolves in the propagation project should likely be considered as a hedge against unforeseen future possibilities.

Prime Objective of Recovery Plan

In formulating a recovery-plan objective for any subspecies of *C. lupus*, one must realistically view, not only the causes of the wolf's past endangerment, but also present trends toward ever-increasing human needs --- whether real or perceived --- for space and for the renewable and nonrenewable resources present or producible in wolf habitat. Having taken this realistic view, the Mexican Wolf Recovery Team sees no possibility for complete delisting of the Mexican wolf.

Section 4(g) of the Endangered Species Act of 1973 requires that recovery plans be developed and implemented "for the conservation and survival of endangered and threatened species...." The team feels that conserving and ensuring the survival of the Mexican wolf is the most that can be achieved today and has worded its prime objective accordingly: "To conserve and ensure the survival of *Canis lupus baileyi* by maintaining a captive breeding program and re-establishing a viable, self-sustaining population of at least 100 Mexican wolves in the middle to high elevations of a 5,000-square-mile area within the Mexican wolf's historic range."

Two factors enter into this quantified objective: (1) the estimated area needed to support one Mexican wolf in average habitat available in this wolf's historic range, and (2) the number of wolves deemed advisable for adequate genetic diversity in an interbreeding population.

It must be emphasized that the Mexican Wolf Recovery Team, unlike the Eastern Timber Wolf Recovery Team for example, has no existing, normal wild population of wolves of the pertinent subspecies to study for information on the average densities of wolves nor on average number of deer and other prey animals required yearly to support one wolf. Normal Mexican wolf populations were gone before an adequate body of scientifically acquired data was amassed on the subspecies. The quantified definition that this team provides therefore represents a working hypothesis. While the hypothesis is soundly based on good data on other subspecies and on captive Mexican wolves, it is subject to amendment as more data on the Mexican wolf are acquired.

The recommended target size of the gene pool is affected in part by the probability of a rather low upper limit on genetic diversity possible from the present breeding program stock. At the time of this writing, the Mexican wolf captive breeding program includes ten wolves: one adult female, eight direct offspring of that female (four from one sire, four from another sire), and one wild-caught male that may be a son of the adult female. If no more stock can be added to the program except by reproduction of existing captives, we cannot appreciably increase the genetic diversity of the captive population from which releases would be made. We can, however, maximize the genetic diversity possible from such a start by breeding as many wolves as possible, given the availability of places to put them, whether in captivity or in the wild, thereby utilizing as many as possible of the varieties of genetic mixes created by mitotic shufflings. In re-establishment of wild populations, we can continue this attempt to maximize whatever genetic diversity is possible from our original stock. We can do this by releasing more than one "family" of wolves in an area, rather than electing to populate an area solely with the progeny of one released "family," a procedure which would intensify inbreeding in that group. In fact, the more "families" we release in an area, the more genetic mixes (as available from the founding stock) in the area and the greater the protection against continued close inbreeding.

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PART II. STEP-DOWN PLAN*

A PLAN FOR THE RECOVERY OF THE MEXICAN WOLF (*Canis lupus baileyi*)**

Prime objective: To conserve and ensure the survival of *Canis lupus baileyi* by maintaining a captive breeding program and re-establishing a viable, self-sustaining population of at least 100 Mexican wolves in the middle to high elevations of a 5,000-square-mile area within the Mexican wolf's historic range.**

1. Inventory and evaluate remaining gene pool.

11. Determine existing numbers and past and present distribution of wild wolves within and adjoining historic ranges of C. *l. baileyi*, C. *l. monstrabilis* and C. L. *mogollonensis*.

111. In cooperation with Fauna Silvestre, compile data on past and present wolf populations in Mexico.

111-1. Compile information on past distribution and status of wolves in Mexico, including search of literature and other records and interviews with persons with pertinent knowledge.

111-2. Determine present distribution and numbers of wolves in Mexico through field surveys and recording and investigation of reports of wolf sightings and wolf depredations.

112. Compile data on past and present wolf populations within and adjoining historic ranges of C. *l. baileyi*, C. L. *monstrabilis* and C. *l. mogollonensis* in the United States (in Arizona, Texas and New Mexico).

112-1. Assess past distribution and status of wolves in these areas through search of literature and other records and interviews with persons with pertinent knowledge.

112-2. Compile data on recent presence of wolves in these historic ranges, using standardized reporting procedures and forms distributed to involved agencies, groups and individuals.

112-21. Compile existing and new reports of sightings, available from files of U. S. Forest Service and other agencies and individuals.

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*In the step-down plan and its diagram, the numbering of tasks does not necessarily indicate chronological order (not a flow chart); differently numbered tasks may proceed concurrently. The numbering system is that of the FWS guidelines (completion of combination of lower-echelon tasks accomplishes the pertinent upper-echelon task).

**See section on "Taxonomic and Geographic Purview of the Plan."

112-22. Investigate new reports of sightings as seems warranted by frequency of reports from a likely area and similar factors.

12. Determine locations, numbers and genealogies of captive wolves that may be *C. l. baileyi*, *C. l. monstrabilis* or *C. l. mogollonensis*.

13. Clarify taxonomic status of wild and captive wolves of subspecies pertinent to this recovery effort.

131. Using historic specimens, re-evaluate subspeciation of *C. lupus* within Mexico, southern Arizona, southern New Mexico, and Trans-Pecos Texas.

132. Using historic specimens and specimens recently obtained from within the areas listed in 131, assess degree to which recent specimens approximate historic specimens and evaluate significance to recovery effort of any noted divergence, especially with respect to any detected hybridization and other changes due to possible genetic or environmental causes.

133. Assess taxonomic affinities of existing captive wolves thought to be *C. l. baileyi*, *C. l. monstrabilis* or *C. l. mogollonensis* and evaluate the suitability and acceptability of use of these animals in recovery-program-related research and propagation.

2. Protect remaining gene pool.*

21. Ensure legal protection of wild wolves in Mexico, Arizona, New Mexico and Texas.

211. Ascertain legal status of wolves in this area; where legal status does not clearly mandate complete protection at both federal and state levels, encourage passage of laws that mandate such protection.

212. Encourage full enforcement of protective laws and regulations.

212-1. Publicize federal and state protective laws and their penalties for violations, and foster public support of the laws, explaining the status of the Mexican wolf and the necessity for protective rules.

*A determination that the Mexican wolf was considered extinct in the wild would obviate the need to continue most tasks listed in steps 212, 22 and 27. These steps might also be discontinued if the U. S. Fish and Wildlife Service and the Dirección General de la Fauna Silvestre concluded that location and capture of any remaining wolf or wolves would be too difficult and expensive. If wolves are reintroduced, steps similar to the steps listed are included in the plan to protect and benefit the released wolves as 345, 344, and 323-3.

212-2. Seek vigorous enforcement of laws protecting Mexican wolves and imposition of maximum legal penalties for intentional violations of these laws; harassing or penalizing persons who accidentally take wolves should be avoided to prevent loss of information about the wolves taken.

22. Protect wild Mexican wolves from being killed in predator control and fur trapping efforts.

221. Devise and initiate methods to handle livestock depredation by wolves other than the current practice of killing offending wolves.

221-1. Personnel of Fauna Silvestre and Fish and Wildlife Service will attempt to remove offending wolves live for use in propagation or translocation efforts of the recovery program.

221-2. Advise ranchers of illegality of wolf control except by Fauna Silvestre or Fish and Wildlife Service.

221-3. Determine existence of any wolf bounties offered by individuals or organizations; advise persons involved of proper legal procedures for livestock protection and the penalties for illegal action.

222. Protect wild Mexican wolves from threats offered them by predator control and fur trapping efforts not directed specifically against wolves.

222-1. Determine extent to which any particular predator control or legal trapping effort, existing or proposed, jeopardizes wild wolves.

222-2. If trapping or predator control jeopardizes wild wolves, seek ways to protect wolves with as little interference as possible with legal fur trapping or with justifiable efforts to protect livestock from other predators.

222-21. Devise and support trapping regulations (e. g., trap-size specifications) that lessen risks of accidentally catching wolves.

222-22. Educate trappers in trapping techniques that minimize risks to wolves.

222-23. Assist livestock raisers in predator control efforts by aiding them in actual control work and by teaching them how to catch coyotes and other predators without using toxicants.

222-3. Remove alive jeopardized wolves for use in propagation or translocation efforts of recovery program.

23. If results of actions under 133 indicate other individual captive wolves are useful to attainment of the prime objective, ensure survival of the wolves involved.

231. Clarify the wolves' legal status and obtain any required permits for their continuing custody.

232. Where necessary, provide cooperative agreements or other indicated actions to ensure continuing care of the animals for the duration of their possible use in the recovery program.

24. Research the ecology, behavior, genetics, food and water requirements, and natural history of Mexican wolves in order to maximize effectiveness of recovery program; in particular, note and analyze any points of difference between Mexican wolves and wolves of northern subspecies.

241. Review literature for appropriate information.

242. Compile information derived from statements made by trappers, ranchers and other observers about wild Mexican wolves.

243. Observe behavior of captive Mexican wolves and obtain other biological data from specimens, provided such study and specimen-taking do not in any way jeopardize success of the recovery effort's captive breeding program. Make collected data on anatomical, physiological and behavioral norms available to all cooperating holding and breeding facilities established under 311.

244. With same caveat as in 243, obtain blood and tissue samples from captive Mexican wolves for canid genetics research for ultimate purpose of being able to perpetuate specimens closest to the *baileyi* genotype.

245. Conserve carcasses of all dead Mexican wolves, including any produced under 31, for same curation and taxonomic assessment as performed under 132.

246. Study wild wolves, if suitable numbers should be discovered, only when survival of Mexican wolves is assured to the point that such study no longer constitutes harassment prejudicial to perpetuation of the subspecies.

247. Whenever research conclusions so indicate, alter plan and husbandry and management practices to enhance production and survival of wolves.

25. Obtain and store specimens of sperm, ova and other tissues from known-origin Mexican wolves, solely to prevent extinction of the Mexican wolf.

26. Stimulate public interest in and support of efforts to perpetuate survival of wolves in Mexico and southwestern United States.

261. Publicize information about wolves in Mexico and southwestern United States, their status, and efforts to prevent their extinction.

261-1. Publish technical data, as obtained, in appropriate journals and bulletins.

261-2. Provide media and societies and organizations interested in wolves with factual information about Mexican wolf behavior, history, ecology and management and about Mexican wolf recovery effort.

261-3. Produce and distribute and/or encourage production and distribution of literature and audiovisual programs and materials about the history, status, ecology, conservation and management of Mexican wolves.

262. In recovery-program publicity, mention contributions made to the recovery effort by cooperating institutions.

27. Establish protective reserves in areas where Mexican wolves still exist in the wild.

3. Re-establish and maintain viable wild populations of Mexican wolves in at least two areas in Mexico and/or adjoining areas of southwestern United States.

31. Propagate Mexican wolves in captivity.

311. Designate and construct facilities to receive, hold and propagate Mexican wolves.

311-1. Establish guidelines for selection and/or construction of facilities and for management and husbandry of program wolves in approved facilities (Appendix II).

311-2. Screen candidate facilities and conclude written agreements with selected facilities regarding procedures, financing, supervision, extent of responsibility, and other facets of the holding-propagating program, including conditions for termination of agreement. Final selection and approval of any facility should be by consent of both Fish and Wildlife Service and Fauna Silvestre.

311-3. Construct holding-breeding enclosure(s) in natural area(s) in Mexico and/or United States within historic range of *C. l. baileyi, monstrabilis* or *mogollonensis*, preferably in area potentially suitable as a release area (Appendix II).

312. Obtain wolves for propagation program.

312-1. Obtain any required federal and state, Mexican and United States permits for trapping, handling, transporting, holding and propagating wolves.

312-2. Locate and capture wild Mexican wolves; transport them to facility appointed to receive them.

312-3. Offer rewards for live wolves and for information leading to capture of live wolves ($500 per wolf suggested).

312-4. Transport to appointed facility any wolves taken into protective custody under 221-1 or 222-3.

312-5. If deemed necessary to the program and acceptable as a result of steps taken under 133 and 23, acquire approved captive wolves.

313. Assign identifying number to each wolf acquired, tattoo wolf with that number, maintain studbook and ISIS (International Species Inventory System) and other records to show genealogies, histories and dispositions of all program wolves.

314. Screen histories, physical condition and taxonomic affinities of acquired wolves to assess their acceptability for use in the propagation program, or for release (without entry into the propagation program) to approved release sites or to approved facilities as indicated and required for program objectives.

315. Provide wolves with food, water, veterinary and other care as recommended in guidelines (Appendix II).

316. Manage propagation.

316-1. Pair wolves on basis of greatest behavioral compatibility and factors indicative of fertility.

316-2. Permit young to be nurtured by and associated with adult pair, except when separation from either or both parents is indicated to ensure welfare of young, in which case hand-rear.

316-3. Examine and monitor young produced to evaluate their health, vigor, conformity to known characteristics of Mexican wolves, and suitability for release and/or further propagation on bases of physical and behavioral attributes, including socialization to humans.

316-4. Adjust pairings and management practices, as indicated by results, to produce most acceptable and viable stock to meet objectives of release program.

316-5. Consider use of artificial insemination if the procedure is vital to advance the objective of the recovery program.

316-6. Distribute acceptable wolves to approved facilities for further propagation or to release project.

316-7. Maintain maximum genetic diversity by producing and retaining in captivity or providing to release project as many progeny as is possible under limitations of space available in breeding-holding facilities or approved releases; euthanize only those wolves produced that absolutely cannot be so accommodated; limit production only when 10 or more wolves must be so euthanized.

32. Select and prepare release areas.

321. Formulate guidelines delineating minimum requirements for an acceptable release area and listing additional factors that would enhance an area's desirability as a release site.

322. Select release areas.

322-1. Determine biological and ecological features of each candidate area: size, topography and other geologic factors; climate; availability of surface water; vegetative make-up; estimated numbers and distribution of wild prey species and competitors; presence in area of endangered species, especially endangered prey species; livestock use of area, including kinds and numbers of livestock, seasonal patterns of use, and evaluation of impact of existing livestock use on habitat and on wild ungulates and other species of possible importance to wolves as prey; presence of any natural or artificial perimeter obstacles to wolf emigration; other pertinent factors.

322-2. Determine economic and sociological values of existing human use of each candidate area: economic value of existing grazing and other agricultural use; existing predator control methods in and near area; nature and economic value of hunting and other recreational uses of area; extents and values of other human uses of area.

322-3. Evaluate suitability of each candidate area in light of Mexican wolves' prey requirements, behavior, population dynamics and other factors, extrapolating from information known about other subspecies of wolves when pertinent information is lacking for Mexican wolves.

322-31. Evaluate such suitability of the area as it actually exists and is used.

322-32. Evaluate potential and costs of altering management and existing use of the area to make it more favorable to production of a viable wolf population.

322-4. Select areas most favorable to production of viable wolf population with least need and expenditures for further habitat management and alteration of existing use patterns, using criteria established in guidelines.

323. Remove regulatory and socioeconomic obstacles to release of Mexican wolves in the selected area.

323-1. Confer with and obtain release permission from any agencies empowered to permit or deny the release, altering release proposal as necessary for acceptability without endangering viability of released wolves.

323-2. Complete any required environmental impact statements or other environmental assessment procedures, including public hearings.

323-3. Clarify legal status of released wolves and release area.

323-31. Classify released wolves as threatened or, if Endangered Species Act has been amended to provide for the classification of experiment population, classify released wolves as an experimental population.

323-32. Under agreement(s) with state(s) or country involved, provide for management of released wolves under a zoned-area system with varying degrees of protection.

323-4. Consider measures to mitigate economic loss to persons who use release area for livestock grazing, e. g., reduction of grazing fees or compensation for losses.

323-5. Publicize and seek public support for release, including information about the status of the Mexican wolf and the reasons for the release proposal and pertinent facts about Mexican wolf behavior, ecology and management.

324. Where necessary and permissible, alter habitat management and/or existing use patterns of release area to enhance survival of released wolves.

324-1. Increase population of wild prey species important to wolves.

324-11. Increase forage available to wild prey species.

324-12. If necessary, limit harvests of prey populations or specific segments of those populations.

324-2. Control numbers of other wild predators that may compete with wolves in the release area.

324-3. Consider feral dog control to eliminate competition and possibility of hybridization, if feral dogs are numerous in or near release area.

324-4. Consider temporary restriction of human access to areas of importance to Mexican wolf survival within the release area.

33. Release Mexican wolves in selected, approved and prepared areas. (NB: If step 311-3 has been adopted, enclosure will have already been constructed, food and water already provided, and various other steps in 332, 333, and 334 already taken.)

331. Formulate guidelines for release procedures for various types of wolf groupings and various kinds of release areas (see also recommended scenario under "Holding-Breeding Enclosures in Release Areas").

332. Prepare release area for acclimation-holding of wolves.

332-1. In release area, construct enclosure appropriate to area and to type of wolf group to be released.

332-2. Accumulate supplies of prey animals and other items that will be fed to wolves, screening wild prey carcasses for their content of pesticides, heavy metals and other toxic materials.

332-3. Provide source of water, if natural open water source is not available in enclosure.

333. Select, prepare and transport wolves.

333-1. Select wolves to be released, these to be a mated pair or family group, in condition of good health and reproductive vigor, not socialized to humans.

333-2. Prepare wolves for release: examine, give any indicated immunizations or other medical treatment; re-tattoo if necessary; affix ear-tags or radio transmitters if so indicated; record all data involved.

333-3. Immediately after preparation, load wolves and transport to release area.

333-4. Release wolves in prepared enclosure.

334. Acclimate and condition wolves for release.

334-1. Hold wolves in enclosure for appropriate period.

334-2. Feed wolves local prey animals -- carcass at first, then live prey -- attempting to disassociate food arrival with human presence. Provide water as needed.

334-3. Observe and record wolf behavior, as far as possible without accustoming wolves to human presence, in order to obtain any information that may enhance recovery program's chances of success.

335. Release wolves.

335-1. Open enclosure, allowing wolves to go and return at will.

335-2. Provide wild prey carcasses or other food supply near enclosure.

335-3. After appropriate period, remove or close enclosure in wolves' absence and discontinue providing food.

34. Enhance survival and increase of released wolves.

341. Conduct research and utilize its findings to improve recovery effort.

341-1. Monitor released wolves, accumulating information with as little disturbance to wolves as possible so as not to affect adversely their survival, reproduction or willingness to stay in the area; among factors to be studied: survival, increase, decrease, and other aspects of population dynamics; food habits; behavior, including activity cycles and movement patterns; tendencies to emigrate from release area; characteristics of specific areas used by wolves and nature of particular use; interactions with humans and human concerns.

341-2. Study changes in area's biota through extended period after release of wolves.

341-3. Continue research on habitat management and other factors affecting populations of prey species.

341-4. Compile information on wolf depredations on livestock in and near release area.

341-5. Compile information on human reactions to presence of wolves in the area, including both incidents and opinions.

341-6. Compile data on violations of laws and regulations protecting wolves released in the area, to include numbers and natures of violations and extent of prosecution and penalties.

341-7. Utilize findings of research to alter management practices, including pre-release steps, and to alter regulations and rules, as indicated, to improve survival of present and future released wolves.

342. Continue to improve and protect habitat and its associated prey base.

342-1. As necessary, continue to improve prey base as done pre-release under 324-1.

342-2. Monitor land-use planning and proposed developments in vicinity of release area; assess probable effects of plans and proposals on wolf populations; seek to mitigate any adverse effects and to promote procedures that would enhance survival of wolves.

342-3. Encourage consideration of wolves' needs in all environmental impact and assessment statements and other planning and project proposals by federal and state agencies.

342-4. Seek and initiate steps to limit human access to areas critical to survival and reproduction of wolves, including acquisition, if so indicated and financially possible.

343. Reduce, as much as possible, adverse effects on recovery efforts caused by emigration of wolves from the release area.

343-1. Research and apply techniques for inducing wolves to stay within the perimeters of the release area

343-2. Handle problem of emigrant wolves.

343-21. Decide whether emigrant wolves are to be: allowed free to take their chances under management programs of the state or country involved, or shot or trapped by authorized personnel and returned to some aspect of the recovery program.

343-22. Take decided action.

344. Continue to seek and take steps to reduce conflicts between wolves and human concerns.

344-1. Attempt to reduce conflicts caused by wolf-livestock problems.

344-11. Evaluate extent of economic losses caused by wolf predation.

344-12. Research and establish procedures to minimize and mitigate losses.

344-121. Consider reparations or other means to compensate ranchers.

344-122. Consider reducing grazing fees in federally controlled areas with released wolves.

344-123. Consider speedy investigation of loss reports and removal or control of offending wolves by authorized management personnel.

344-124. Seek application of any techniques for minimizing livestock predation that have been tested and proven effective (these might include guarding dogs, taste aversion, etc.).

344-2. Attempt to foster favorable attitudes toward wolves among the public.

344-21. Publicize factual information about Mexican wolves, their status, conservation, management, and behavior, emphasizing that humans need not fear wolves.

344-22. Publicize the possibility of future recreational and other benefits to be gained from established wolf populations.

344-3. Attempt to reduce any conflicts between welfare of released wolves and legitimate predator and rodent control and fur trapping efforts not directed specifically against wolves, as done pre-release under 222.

345. Continue to support vigorous enforcement of laws protecting wolves.

346. Coordinate research and management efforts that involve or affect wolves in order to most effectively and least expensively achieve the prime objective.

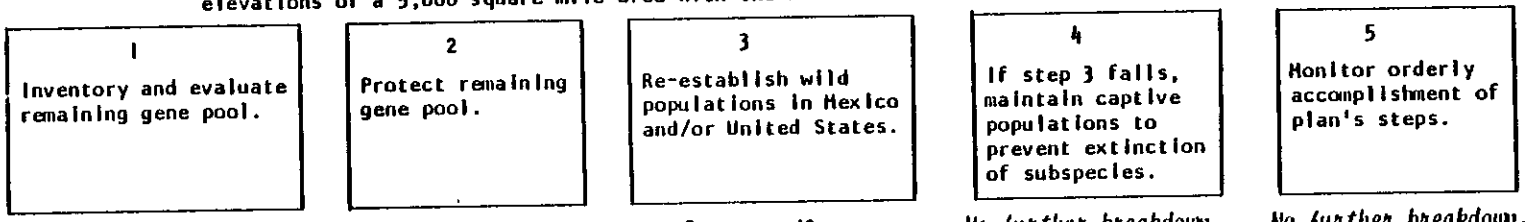
4. If efforts fail to establish and maintain viable wild populations of Mexican wolves anywhere in Mexico or the United States,* declare subspecies extinct in wild and maintain remaining captive Mexican wolves in captivity, managing captive populations so as to prevent extinction of the subspecies and, if possible, genetic degeneration. For this task, the exact mechanisms and assignment of responsibilities are to be determined at the time by agreement between U. S. Fish and Wildlife Service and Dirección General de la Fauna Silvestre after recommendations are obtained from the Mexican Wolf Recovery Team, American Association of Zoological Parks and Aquariums, and International Species Inventory System.

5. Monitor progress of agencies, groups and individuals with assigned task responsibilities to ensure that tasks are accomplished in recommended order of priorities and by target dates.

*In in January 1982, progress of the captive propagation program is still too uncertain to permit the team to recommend a specific date for initiation of Step 4.

RECOVERY PLAN DIAGRAM

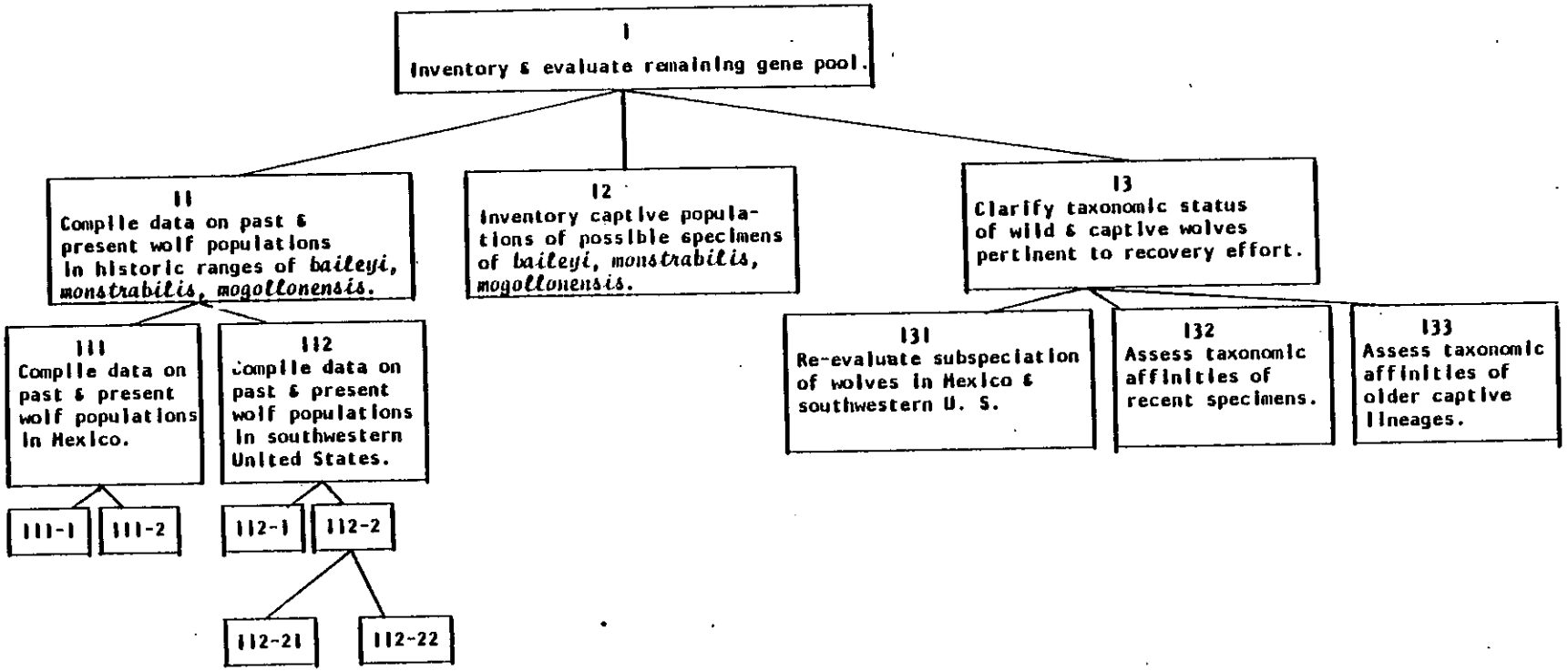
Prime objective: To conserve and ensure the survival of *Canis lupus baileyi* by maintaining a captive breeding program and re-establishing a viable, self-sustaining population of at least 100 Mexican wolves in the middle to high elevations of a 5,000-square-mile area with the Mexican wolf's historic range.

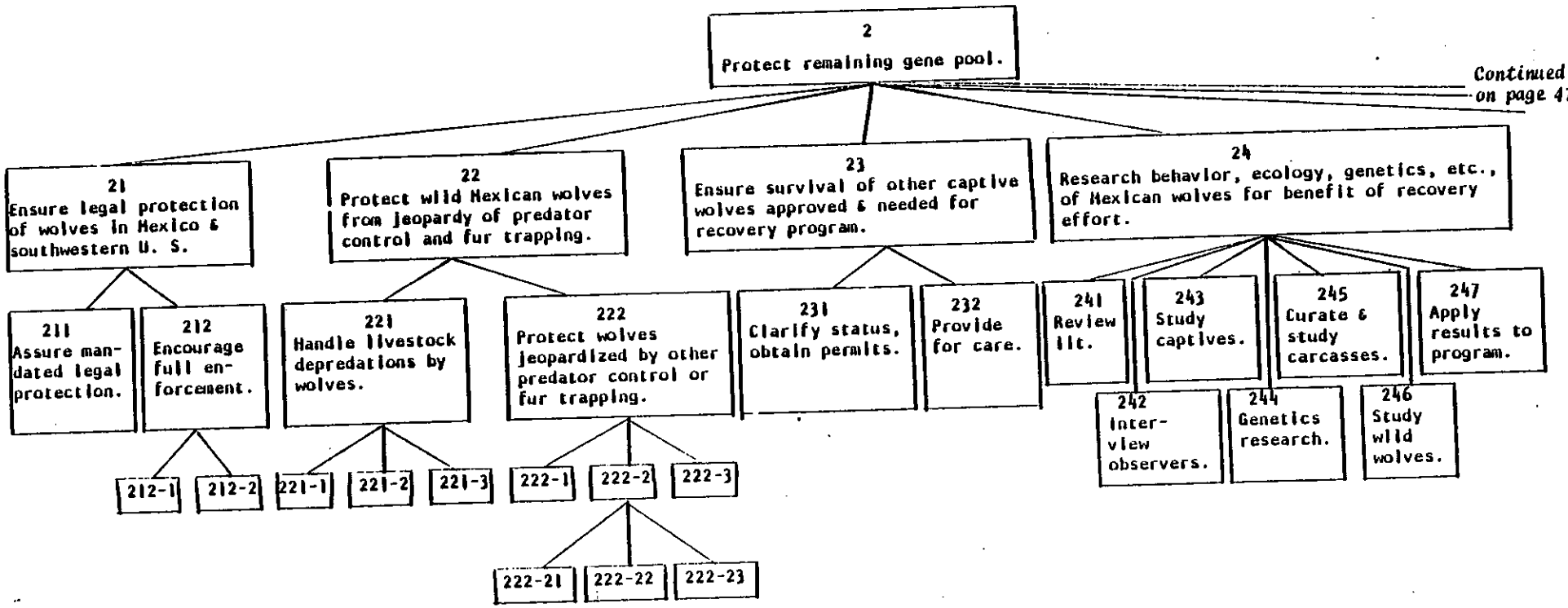


See page 43. *See page 45.* *See page 49.* *No further breakdown.* *No further breakdown.*

NOTE: *On succeeding pages of the diagram, lower-echelon steps include only the numbers of the individual steps. The reader must refer to pages 28 through 40 for descriptions of the actions for these numbered steps. Inclusion of wording would have created a diagram so large that comprehending interrelationships would have been much more difficult. Shortening wording risks misinterpretation due to lack of details and comments included in the step-down plan.*

Numbering of tasks in the diagram does not necessarily indicate chronological order (not a flow chart); differently numbered tasks may proceed concurrently. The numbering system is that of the FWS guidelines (combination of completion of lower-echelon tasks accomplishes the pertinent upper-echelon task).


1
Inventory & evaluate remaining gene pool.
11
Compile data on past & present wolf populations in historic ranges of baileyi, monstrabilis, mogollonensis.
12
Inventory captive populations of possible specimens of baileyi, monstrabilis, mogollonensis.
13
Clarify taxonomic status of wild & captive wolves pertinent to recovery effort.
111
Compile data on past & present wolf populations in Mexico.
112
Compile data on past & present wolf populations in southwestern United States.
131
Re-evaluate subspeciation of wolves in Mexico & southwestern U. S.
132
Assess taxonomic affinities of recent specimens.
133
Assess taxonomic affinities of older captive lineages.
111-1
111-2
112-1
112-2
112-21
112-22


2
Protect remaining gene pool.
Continued on page 47.
21
Ensure legal protection of wolves in Mexico & southwestern U. S.
22
Protect wild Mexican wolves from jeopardy of predator control and fur trapping.
23
Ensure survival of other captive wolves approved & needed for recovery program.
24
Research behavior, ecology, genetics, etc., of Mexican wolves for benefit of recovery effort.
211
Assure mandated legal protection.
212
Encourage full enforcement.
221
Handle livestock depredations by wolves.
222
Protect wolves jeopardized by other predator control or fur trapping.
231
Clarify status, obtain permits.
232
Provide for care.
241
Review lit.
242
Interview observers.
243
Study captives.
244
Genetics research.
245
Curate & study carcasses.
246
Study wild wolves.
247
Apply results to program.
212-1
212-2
221-1
221-2
221-3
222-1
222-2
222-3
222-21
222-22
222-23

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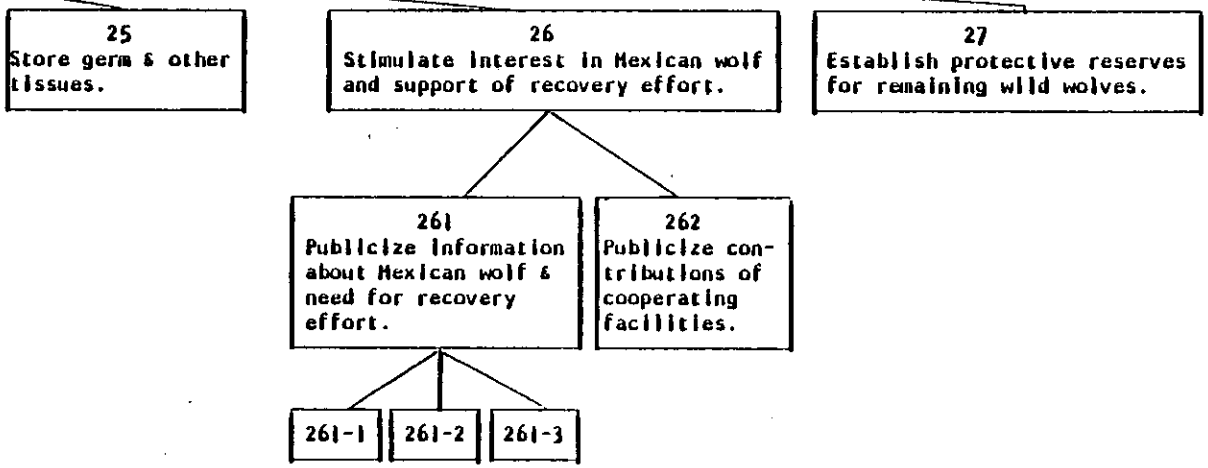

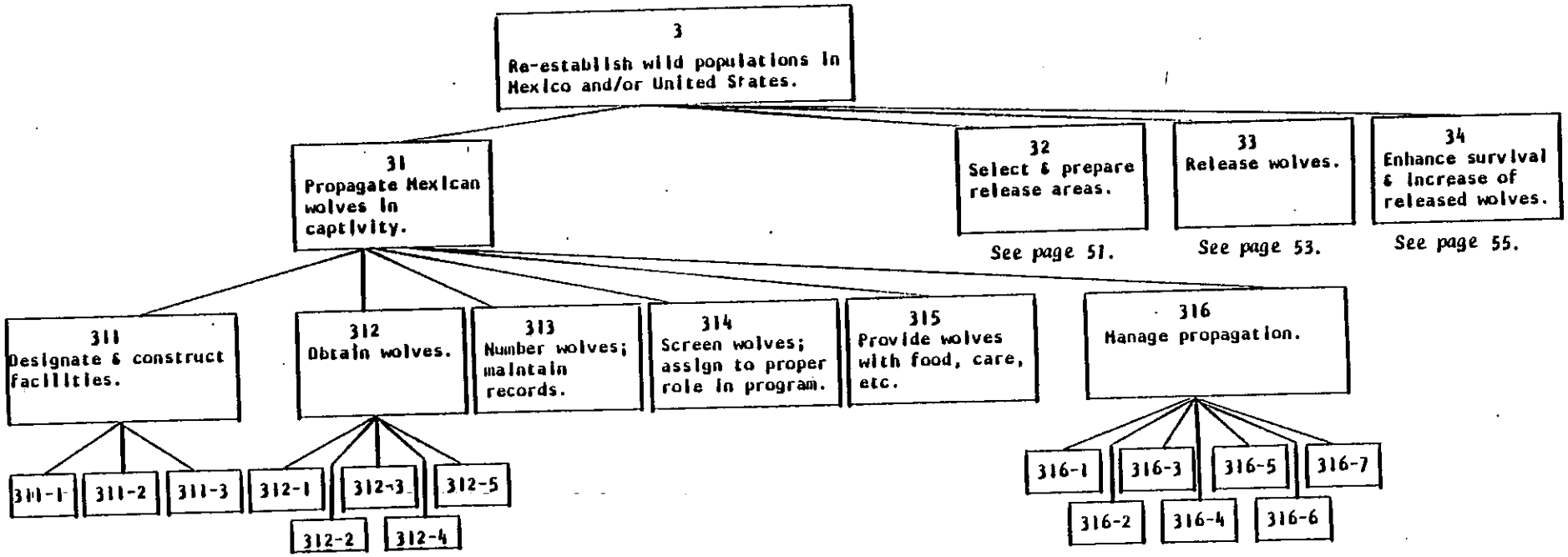
3
Re-establish wild populations in Mexico and/or United States.
31
Propagate Mexican wolves in captivity.
32
Select & prepare release areas.
See page 51.
33
Release wolves.
See page 53.
34
Enhance survival & increase of released wolves.
See page 55.
311
Designate & construct facilities.
312
Obtain wolves.
313
Number wolves; maintain records.
314
Screen wolves; assign to proper role in program.
315
Provide wolves with food, care, etc.
316
Manage propagation.
311-1
311-2
311-3
312-1
312-3
312-5
312-2
312-4
316-1
316-3
316-5
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316-2
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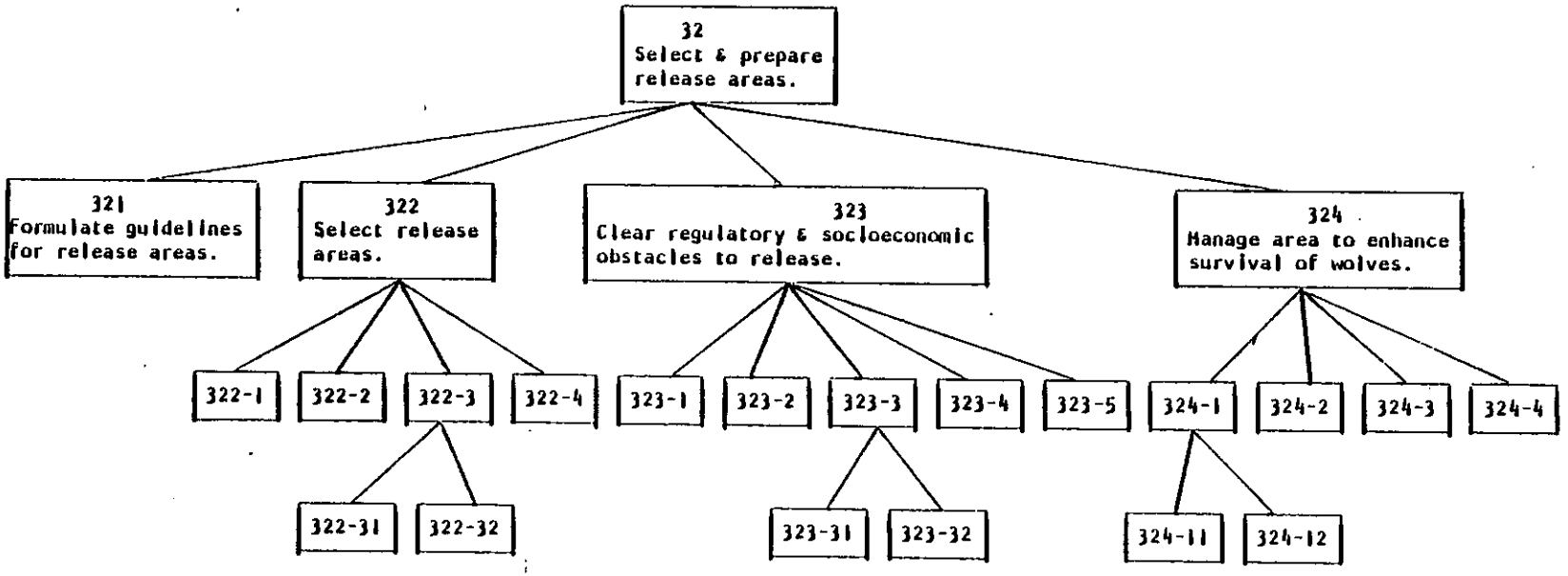
32
Select & prepare release areas.
321
Formulate guidelines for release areas.
322
Select release areas.
323
Clear regulatory & socioeconomic obstacles to release.
324
Manage area to enhance survival of wolves.
322-1
322-2
322-3
322-4
322-31
322-32
323-1
323-2
323-3
323-4
323-5
323-31
323-32
324-1
324-2
324-3
324-4
324-11
324-12

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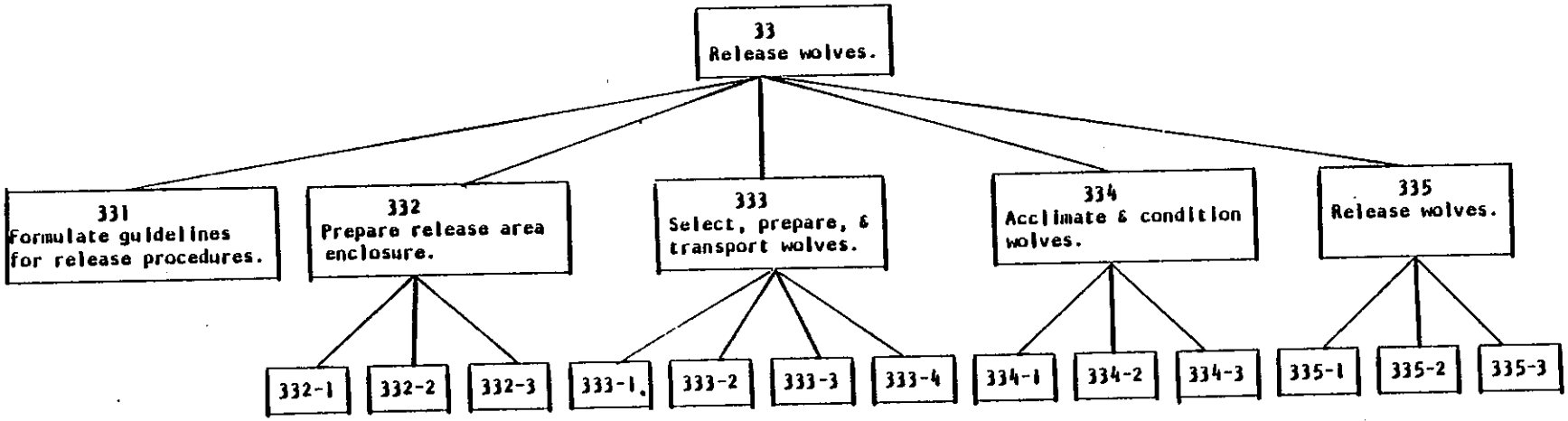
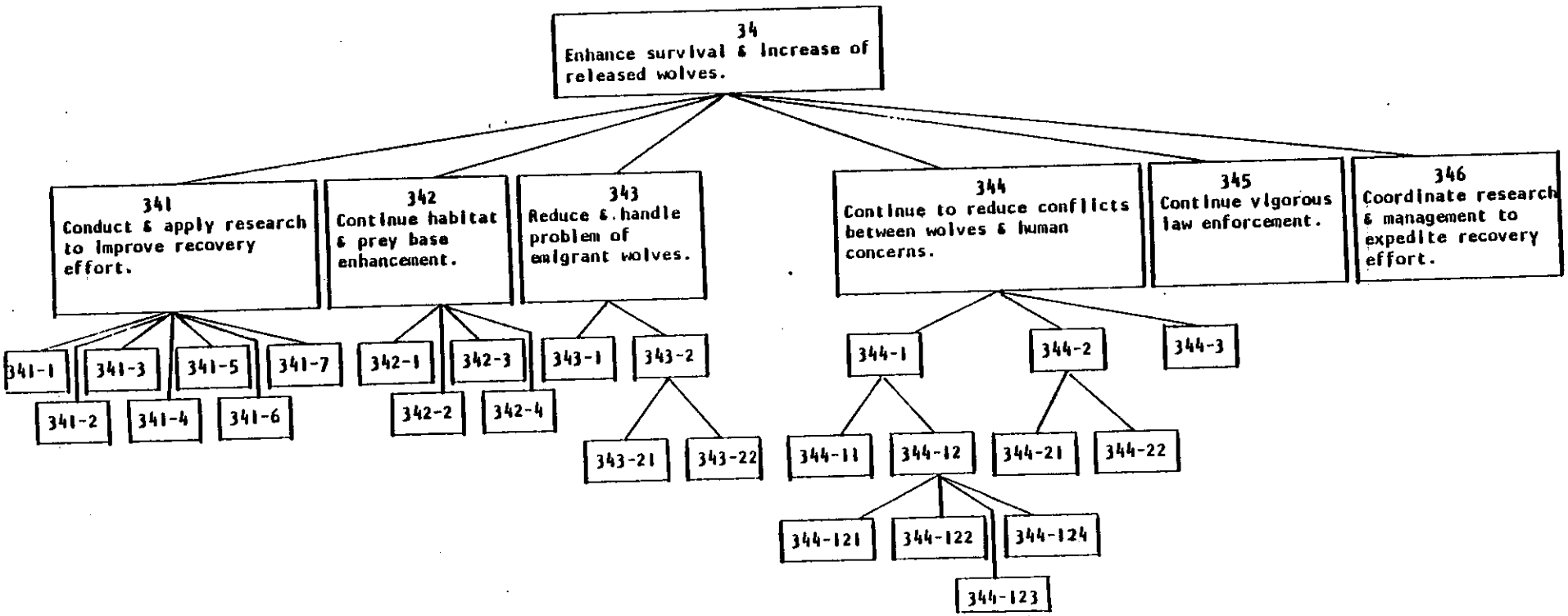

33
Release wolves.
331
Formulate guidelines for release procedures.
332
Prepare release area enclosure.
333
Select, prepare, & transport wolves.
334
Acclimate & condition wolves.
335
Release wolves.
332-1
332-2
332-3
333-1
333-2
333-3
333-4
334-1
334-2
334-3
335-1
335-2
335-3

From page 49.


34
Enhance survival & increase of released wolves.
341
Conduct & apply research to improve recovery effort.
342
Continue habitat & prey base enhancement.
343
Reduce & handle problem of emigrant wolves.
344
Continue to reduce conflicts between wolves & human concerns.
345
Continue vigorous law enforcement.
346
Coordinate research & management to expedite recovery effort.
341-1
341-2
341-3
341-4
341-5
341-6
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PART III. IMPLEMENTATION SCHEDULE

Explanation of Abbreviations, Codes and Symbols

Category: Category codes are those requested by U. S. Fish and Wildlife Service for data storage and retrieval, to wit:

R: Information Gathering (FWS provides two codes, I and R; we have grouped all pertinent items under R.)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

M: Management

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator & competitor control
5. Depredation control
6. Disease control
7. Other management

A: Acquisition

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

O: Other

1. Information & education
2. Law enforcement
3. Regulations
4. Administration

Plan Task: See step-down plan for full description of task.

Task Number: The table omits most tasks that are further broken down in the step-down plan into lower-echelon tasks, the combined accomplishment of which constitutes the (omitted) upper-echelon task. Thus, III-1 and III-2 appear in the table, but III does not.

Certain tasks already done are included in the table as matter of information on their status.

Priority: Codes used are those requested by FWS for data storage, to wit:

1. Actions absolutely necessary to prevent extinction of the species or subspecies.
2. Actions necessary to maintain the species' or subspecies' current population status.
3. All other actions necessary to provide for full recovery of the species or subspecies.

Responsibility: Abbreviations used:

AAZPA = American Association of Zoological Parks and Aquariums
DGFS = Dirección General de la Fauna Silvestre
FWS - U. S. Fish and Wildlife Service
FY = Fiscal year from October 1 to the following September 30 in the year named; e. g., FY82 = October 1, 1981, through September 30, 1982
ISIS = International Species Inventory System
NFWL = National Fish and Wildlife Laboratory
NMDGF = New Mexico Department of Game and Fish
States = States of the United States

Other symbols are explained on the page on which they occur.

Estimated Costs: Estimates are made as of early 1981. It is expected that inflation will cause estimates for FY83 and FY84 to increase.

No releases of wolves are anticipated in the three-year period covered by the present schedule. This affects cost estimates for various tasks; e. g., 221-1 would not include costs for removal of depredating released wolves. Similarly, 246 would not include study of released wolves in the wild.

* = Cost estimate for a task that depends on other circumstances for its realization; thus, expenditure might not be needed. For example, 246 would be performed only if a group of wild Mexican wolves were discovered whose location, size and lack of jeopardy permitted their being studied in the wild.

@ = Estimated cost for a task already being done in ongoing programs of the agencies involved, or that would be so done, and therefore does not actually represent a cost added by the recovery program task.

SECTION 1. Inventory and evaluate remaining gene pool.

CATEGORY	PLAN TASK	TASK NUMBER	PRIORITY	RESPONSIBILITY Lead	RESPONSIBILITY Cooperators	TARGET DATE	ESTIMATED COSTS FY82	ESTIMATED COSTS FY83	ESTIMATED COSTS FY84
R-1	Compile information on past distribution and status of wolves in Mexico.	111-1	3	FWS	Contract	1982	$3,000 (Includes 112-1, 241, 242)		
R-1	Determine present distribution and status of wolves in Mexico.	111-2	1	FWS & DGFS	Contract	Ongoing (Partly done)	$50,000 (Survey will include 312-2)	$17,500 on occasion	$7,500* (unless wolf declared extinct in wild)
R-1	Compile information on past distribution and status of wolves in southern Arizona, southern New Mexico & Trans-Pecos Texas.	112-1	3	FWS	Contract	1982 (Partly done)	(Included with 111-1)		
R-1	Compile existing and new reports of sightings (s.w. U.S.).	112-21	2	FWS		1983	$ 500	$ 500	
R-1	Investigate new reports, as warranted.	112-22	1	FWS		Ongoing	$2,500*	$2,500*	$2,500*
R-1	Obtain information on captive wolves that might be *baileyi, monstrabilis* or *mogollonensis*.	12	1	FWS & DGFS		Done			
R-5	Evaluate wolf subspeciation in Mexico and southwestern U. S.	131	1	FWS & NMDGF	Contract - NFWL	Done			
R-5	Assess taxonomic affinities of recently caught specimens from Mexico.	132	1	FWS & NMDGF	Contract - NFWL	Ongoing (Partly done)	$2,500 (As specimens occur; Includes 133 & 245)	$3,000	$3,000
R-5	Assess taxonomic affinities of captive specimens from earlier lineages.	133	1	FWS & NMDGF	Contract - NFWL	Ongoing (Partly done)	(Included with 132)	; If so decided; see Appendix 1.	

See page 58 for explanation of abbreviations, codes, & symbols.

SECTION 2. Protect remaining gene pool.

CATEGORY	PLAN TASK	TASK NUMBER	PRIORITY	RESPONSIBILITY Lead	RESPONSIBILITY Cooperators	TARGET DATE	ESTIMATED COSTS FY82	FY83	FY84
O-3	Provide laws protecting wolves in Mexico, Arizona, New Mexico and Texas.	211	1	FWS & DGFS	States	Done			
O-1	Publicize and foster support of protective laws.	212-1#	1	FWS & DGFS	States	Ongoing	$2,000	$1,000	$1,000*
O-2	Seek full enforcement & maximum penalties for intentional violations.	212-2#	1	FWS & DGFS	States	Ongoing	@	@	@
M-5	Remove depredating wolves alive.	221-1#	1	FWS & DGFS	Contract	Ongoing	$5,000*	$5,000* (includes 222-3)	$1,000*
M-5	Advise ranchers of legal procedures for removing wolves.	221-2#	1	DGFS & FWS		Ongoing	@	@	@
O-2	Determine & eliminate any wolf bounties.	221-3#	1	DGFS & FWS	States	Ongoing	(Included in 212-2)		
M-4	Evaluate threat of wolves from any predator control or fur trapping effort.	222-1#	2	DGFS		Ongoing	@	@	@
O-3	If needed, alter trapping regulations to reduce risks to wolves.	222-21#	2	DGFS		Ongoing	@	@	@
O-1	Teach trapping techniques that reduce risks to wolves.	222-22#	2	DGFS		Ongoing	@	@	@
M-4	Assist and teach ranchers in predator control.	222-23#	3	DGFS		Ongoing	@	@	@
M-5	Remove jeopardized wolves alive.	222-3#	1	FWS & DGFS	Contract	Ongoing	(Included in 221-1)		
M-7	Protect any captive wolves needed for recovery program.	23	1	FWS & DGFS		1982	$2,500*		
R- All categories	Review literature.	241	3	FWS & DGFS	Contract	1982	(Included with 111-1)		
	Interview observers.	242	3	FWS & DGFS	Contract	1982	(Included with 111-1)		
	Study captive specimens.	243	3	FWS & DGFS	Cooperating facilities	Ongoing	@	@	@
	Provide samples for genetics research.	244	3	FWS & DGFS	Cooperating facilities	Ongoing	$1,000	$2,000	$3,000
	Assess taxonomic affinities of captives that die.	245	3	FWS & DGFS	Contract - NFWL	Ongoing	(Included in 132)		
	Study Mexican wolves in wild.	246	3	FWS & DGFS	Contract	Ongoing	$5,000*	$5,000*	$5,000*
O-4	Alter program as indicated by research.	247	3	FWS & DGFS		Ongoing	$3,000*	$3,000*	$3,000*
M-1	Obtain and store germ tissues, if necessary to provent extinction.	25	1	FWS & DGFS	Contract	Ongoing	$5,000*	$4,000*	$1,000*
O-1	Publish technical data.	261-1	3	FWS & DGFS	Research contractors	Ongoing		$1,000*	$3,000*
O-1	Provide information to media & interested groups.	261-2	3	FWS & DGFS	Cooperating facilities	Ongoing	$1,000	$1,000	$1,000
O-1	Produce & disseminate literature & audiovisual presentations.	261-3	3	FWS & DGFS	Contract	Ongoing	$10,000	$25,000	$25,000

#Tasks that may be discontinued under certain circumstances; see footnote, page 29. See page 58 for other abbreviations, codes & symbols.

SECTION 2, continued.

CATEGORY	PLAN TASK	TASK NUMBER	PRIORITY	RESPONSIBILITY Lead	RESPONSIBILITY Cooperators	TARGET DATE	ESTIMATED COSTS FY82	ESTIMATED COSTS FY83	ESTIMATED COSTS FY84
O-1	Publicize contributions of coop. facilities.	262	3	FWS		Ongoing	(Included in 261, general)		
A-7	Establish protective reserves where wild Mexican wolves still exist.	27	1	DGFS		Ongoing	$50,000	$50,000	$50,000

SECTION 3. Re-establish in wild.

CATEGORY	PLAN TASK	TASK NUMBER	PRIORITY	RESPONSIBILITY Lead	RESPONSIBILITY Cooperators	TARGET DATE	ESTIMATED COSTS FY82	ESTIMATED COSTS FY83	ESTIMATED COSTS FY84
M-1	Establish guidelines for holding/breeding facilities and husbandry practices.	311-1	1	NWRT		Done			
A-3	Select facilities; conclude agreements.	311-2	1	FWS & DGFS	Zoological facilities	Ongoing	$2,000 ea. facility	$2,000* ea. facility	Likely no need
A-All categories are possible.	Construct natural-area holding/breeding enclosure(s)	311-3	1	FWS & DGFS	Agency or person controlling land	1983		$150,000 ea. enclosure	
O-4	Obtain required permits.	312-1	1	FWS & DGFS	States	Ongoing	$ 500	$ 500	$ 500
M-7	Capture & transport wolves.	312-2	1	FWS & DGFS	Contract	Ongoing	$5,000	$5,000	$5,000*
O-4	Offer rewards for live wolves.	312-3	1	FWS & DGFS		Ongoing	$2,000	$2,000	$2,000
M-7	Transport to facility wolves taken under 221-1 and 222-3.	312-4	1	FWS & DGFS		Ongoing	(Included in 312-2)		
M-7	Transport to facility any wolves acquired under 133 and 23.	312-5	2,	FWS		Ongoing	(Included in 312-2)		
M-7	Identify wolves by number, maintain records.	313	3	Studbook keeper	Cooperating facilities	Ongoing	$ 150	$ 500	$1,000
M-7	Screen & assign wolves.	314	2	FWS & DGFS		Ongoing	$ 500	$ 750	$1,000
M-7	Provide wolves with food & care:	315	1	FWS & DGFS	Cooperating facilities	Ongoing			
	Facility maintenance & upkeep								$5,000
	Facility manning							$30,000	$30,000
	Food, etc., for wolves						$800/wolf	$900/wolf	$1,000/wolf
M-1	Manage propagation	316	1	FWS & DGFS	Cooperating facilities	Ongoing	$3,000	$4,000	$5,000
M-2	Establish guidelines for release areas	321	3	NWRT		1982 (Partly done)			
R, M, A, O -all various as needed	Select, obtain approval of, prepare release areas.	322 thru 324	3	FWS & DGFS	NWRT, state & agencies involved*	1984 & subsequent			$100,000
Various	Release wolves, enhance survival	33, 34	3	FWS & DGFS	States & agencies involved*	(Tasks not anticipated to occur in this three-year period)			
	SECTION 4.								
M-1 & A-3	Maintain captive populations if no wild populations re-established.	4	1	FWS & DGFS	(Task omissible if Sec. 3 successful)				
	SECTION 5.								
O-4	Monitor program.	5	3	FWS & DGFS		Ongoing	$2,000	$2,000	$2,000

See page 53 for explanation of abbreviations, codes, & symbols.

*See explanatory material in closing paragraphs of narrative's section on "Release Areas - Habitat Considerations."

THE GENETIC BASE FOR THE MEXICAN WOLF CAPTIVE BREEDING PROGRAM

Norma Ames, Leader, Mexican Wolf Recovery Team
March 1981

The Problem

As of March 1981, the following eight (7.1) wolves are in captivity as part of the joint U. S. A.-Mexico program for recovery of the Mexican wolf (*Canis lupus baileyi*):*

Sex	Identification Number	Est. Age Spring 1981	Date of Capture in Mexico or of Captive Birth
Female	AF005	9 years	Captured March 1978 (pregnant when captured)
Male	AF007	3 years	Born May 1978 to AF005
Male	AF008	3 years	Born May 1978 to AF005
Male	AF009	3 years	Born May 1978 to AF005
Male	AF010	3 years	Born May 1978 to AF005
Male	AF002	4 years	Captured October 1977
Male	AF004	7 years	Captured March 1978
Male	AF011	5 years	Captured March 1980

Through 1980, the sole captive female had not yet reproduced in captivity, and it is, in March 1981, too early to know for certain whether she has mated at the Wild Canid Survival and Research Center, given the desirably hidden habitat offered by that facility.

In June 1980, Roy McBride estimated the remaining wild population of wolves in Mexico at less than 50. At the September 1980 meeting of the USA-Mexico Joint Committee on Wildlife Conservation, José Treviño said he knew of perhaps as many as ten wolves in the wild in Mexico. Although the Mexican officials agreed, at that meeting, to capture as many as possible of the remaining wild wolves, we cannot now predict how many will be successfully captured alive nor the sex and-age breakdown and possible interrelatedness of the group finally captured. In early 1981 Roy McBride investigated certain areas in northern Mexico that he thought offered the best chances for locating wolves for capture. He found none and reportedly came back to the United States discouraged about the prospects of finding more wolves (Curt Carley, pers. comm.). He will return in March 1981 to investigate leads in Durango.

Even if we disregard for the moment the present lack of breeding females in the program, the question must obviously be addressed of whether an adequate number of wolves is available for a breeding program that is on a sound genetic basis. The Southwest Regional Office of the U. S. Fish and Wildlife Service has suggested that the Mexican Wolf Recovery Team provide input on this question. Production of animals from a few parent animals leads to increasing homozygosity. The effects vary according to the make-up of the original gene pool, inasmuch as inbreeding creates homozygosity for beneficial alleles as well as for detrimental ones. Some inbreeding "may be beneficial, serving to eliminate deleterious recessives and thus increase the fitness of the population" (Chai 1976). More often, however, the increase in homozygosity leads eventually to inbreeding depression characterized by a dwindling of fecundity or a diminished ability of the evolving line to respond to

*An updated table appears on page 14 of Appendix I (page 72).

environmental changes. Inbreeding can produce a gene pool without lifeguards.

Examples of Productive Inbred Lines

On the side of optimism, we note the following examples. The examples are not restricted to wolves nor even to carnivores, but are drawn from a variety of taxa. Adequately documented examples of inbred lineages of carnivores are few. The genetic mechanics of inbreeding, however, are similar in higher vertebrates. Thus, these varied examples must suffice to shed some light on the matter.

The New Mexico Department of Game and Fish released in New Mexico a total of 24,448 Afghan white-winged pheasants produced at its game farm from the original stock of three cocks and two hens obtained from Afghanistan (Campbell 1976). Campbell writes: "Luckily there evidently were no serious genetic defects in these few ancestors because their thousands of descendents at the game farm were excellent in every way. The captive birds also retained a comparatively high degree of wildness to the very end of game-farm production more than a decade later. This made raising them rather difficult, but undoubtedly favored their survival after release."

Lee Crandall of the New York Zoological Park (quoted in Ogren 1965) tells of the park's obtaining eight (2.6) Barbary sheep or aoudad in the period from 1901 through 1905, plus an additional male lamb in 1943. He informed Ogren, "No deterioration in the present stock is noticeable." Acquisitions of aoudad at the National Zoological Park were similarly few and also produced large numbers of healthy animals. Ogren states that nearly all sizeable zoos in the United States have aoudad and, with a few exceptions, all apparently derive from the herds of the New York and National Zoological Parks.

The New Mexico Department of Game and Fish imported both Siberian and Iranian ibex in the 1960s, bred them in captivity and released offspring in New Mexico. As accurately as can be determined from existing records (the department's annual reports from 1962-1963 through 1969-1970), the original stock included 2.4 Siberian ibex and 2.6 Iranian ibex. Iranian ibex were first introduced into the Florida Mountains of southwestern New Mexico in December of 1970. Siberian ibex releases came later and were in the Canadian River canyon in northeastern New Mexico. The resulting herds grew to numbers that warranted open hunting seasons, the first in January 1975. For the January-February 1982 ibex hunting seasons --- both kinds combined --- 134 licenses are available. Of these, 34 are for trophy ibex and 100 for beardless ibex. There are apparently no indications of inbreeding depression.

Herskowitz (1977) comments: "No obvious disadvantage seems to have resulted from the brother-sister matings practiced for many generations by the Pharoahs of ancient Egypt. In fact, the success of self-fertilizing species is testimony to the general advantage of homozygosity in some cases."

Those "cases," of course, are the ones in which the founding stock has few genetic defects. Kear (1977) points out that "all the Laysan teal in the

world descend from a tiny number of individuals that were subject to intense selection on Laysan Island before any were brought into captivity. There is no evidence of adverse effects of inbreeding in this duck and it can be assumed that not only are few or no lethal genes present but all individuals are nearly identical genetically. From one pair received in 1958, the Wildfowl Trust has now produced 410 birds and many descendant birds are now breeding elsewhere." Kear also points to Père David's deer, the Chillingham white cattle, and the golden hamster as other "examples of species, races and populations that stem from small numbers without apparent ill effects."

Approaching our specific problem more closely, we note that the captive lineage of wolves formerly held at Arizona-Sonora Desert Museum originated from a male trapped in 1959 near Tumacacori, Arizona, and a female taken as a pup in 1961 near Yecora, Sonora, Mexico. Records on subsequent breeding in the lineage to date reveal none of the decline in fecundity that frequently results from the increasing homozygosity that continued inbreeding produces.

After production of the pair's first litter in 1963, the male was lost, and the female was mated to one of her sons, producing the following litters: six (3.3) in 1965, seven (3.4) in 1966, and nine (3.2.4) in 1967 (Rosacker, in Ames 1980). The original female was then mated to another of her 1963 sons, producing litters of seven in 1968, six in 1969, and five in 1970 (Rosacker, ibid.). A sibling pair from the 1967 litter, sent to Ghost Ranch, Abiquiu, New Mexico, produced litters of four (0.0.4) in 1969, five (3.2) in 1970, seven (5.2) in 1971, seven (5.2) in 1973, five (2.1.2) in 1974, and five (2.3) in 1976 (Ames 1980). Additional progeny may have gone unrecorded. Of these, a male from the 1971 litter and a female from the 1973 litter were paired at Rancho Ma'ii-tsoh, Santa Fe, New Mexico, and in the years they were permitted to mate produced a litter of four (3.0.1) in 1977, six (5.1) in 1978, and six (4.1.1) in 1980 (Ames 1980). Siblings from the 1974 litter at Ghost Ranch were sent to Living Desert State Park, Carlsbad, New Mexico and there produced litters of four (3.1) in 1977 and six (3.3) in 1978 (Ames 1980). Additional wolves produced in this lineage at Arizona-Sonora Desert Museum were sent to other zoological facilities, but records on further production are inadequately detailed.

Despite descent from one original pair, backcrossing and brother-sister matings, the litters recorded for the lineage are normal-sized litters for wolves (a female's first litter and litters of aging females tend to be smaller). The wolves are in general rather uniform in appearance, but there is still adequate variation among individuals, even among litter-mates, to distinguish each individual from all others. Morphological differences between existing wolves of this lineage and wild wolves taken recently in Mexico can be attributed to causes other than inbreeding, as, for example, the changes induced by zoo diets as compared to the killing and eating of prey carcasses. This matter is further elaborated by Ames (1980), but it may be well to note that the descent of the lineage to date involves one backcross, followed by two generations of brother-sister matings. Serious deleterious effects from increasing homozygosity may not yet have appeared in this lineage because high genetic diversity and/or few detrimental genes were present in the original pair. Gardner (1964) indicates it would taken eleven generations of brother-sister inbreeding for 95 percent of the genes originally heterozygous to

become homozygous. Inbreeding degeneration might not appear, however, even with additional brother-sister matings because of an initial absence of many detrimental genes. Winge (1950) recognizes such a possibility when he states that "the best chance for good results in the mating of brothers and sisters arises when the animals used are ones that have been strongly inbred previously but have not been weakened appreciably."

It has been suggested that the wolves of Isle Royale offer an example of a productive, healthy, long-lived lineage that resulted from an original pack of seven wolves. Unfortunately, we cannot use the example because there continued to be winters like that of 1949 when ice permitted wolves to cross between the mainland and the island as they apparently did in 1949. The resulting unknown amount of outbreeding thus invalidates the example.

Some General Genetic Considerations for the Mexican Wolf Breeding Project

Kear (1977) emphasizes that the number of animals needed for a sound captive breeding program "will depend on the number of lethal or deleterious genes carried in the parents" --- an unknown, of course, in the case of the Mexican wolf at this point. Kear also says that "probably most populations of higher vertebrates become extinct if their numbers drop below 50 simply because these individuals carry in their genetic endowment the seeds of their own destruction."

It should be noted that a certain amount of inbreeding is highly likely to occur among wild wolves as a result of the social structure of wolf populations. Nonetheless, *Canis lupus* generally retains a diverse genotype. As the number of wild wolves decreases, however, what breeding there is in the wild is increasingly likely to be inbreeding.

In the recovery program, initial selective breeding will no doubt be considered, in order to produce stock most closely resembling some phenotype. The recovery team wishes to point out that selective breeding can further eliminate some of the original genes, reducing a genetic diversity that might be significant to survival of released wolves in the wild.

If the Mexican wolf is to be saved to exist solely in captivity, it may not matter that our breeding program selects primarily for "purity" of form at the possible cost of eliminating genes affecting behavior that might enhance survival in the wild. For this breeding program, however, detection and elimination of hybrids with other canids is not thought to carry the same importance as it does for the breeding program for red wolves (*Canis rufus*). One of the factors known to contribute to the red wolf's status as endangered was its hybridization with coyotes (*Canis latrans*). Stock captured for captive breeding and progeny of that stock has perforce to be screened to detect and eliminate hybrids as much as possible. Recently wild-caught Mexican wolves are not thought to be hybridized. Secondly, phenotypic standards for the Mexican wolf, as they exist today, are based on a comparatively small sample of skulls and a smaller sample of live wolves described in very recent times by a few observers. Some older observers have in fact commented that wild wolves coming from Mexico today look different from those they remember from years ago. An example of the possibly subjective nature of some of

these standards lies in the resemblance of the Mexican wolf, taken in 1917, of Plate 7 of Volume I of *The Wolves of North America* (Young and Goldman 1944) to the sire of the Arizona-Sonora Desert Museum-Ghost Ranch lineage (Ames 1980, Fig. 1), an animal whose appearance has been said to be not typical of the Mexican wolf. Eliminating from the breeding program animals that deviate from certain subjective standards may be throwing the baby out with the bath. As Benirschke (1977) put it, "cropping of deviant phenotypes should be undertaken only with the greatest of care and full knowledge that it will reduce genetic heterogeneity."

Admittedly, phenotypes are all we have to go on at this point. Karyotypes of *Canis lupus* have been published (e. g., Hungerford and Snyder 1966). Wolf chromosomes, however, cannot yet be distinguished from those of coyotes and dogs, although ongoing work on chromosome banding patterns may soon produce genetic markers, and electrophoretic analysis of blood sera has just begun to produce such results (Ferrell *et al.* 1980). Karyotypic identification of wolf subspecies is not yet possible.

One last genetic caveat for the Mexican wolf captive breeding program is the possibility of selection by the conditions of captivity. As Kear (1977) put it, "very often the stock will become tamer simply because those individuals with a genetic make-up that does not allow them to breed in proximity to man will leave no offspring." Also, "captivity may inadvertently select for physical features such as a particular type of gut associated with a convenient commercial diet" (Kear 1977). The conditions under which the wolves are kept have, therefore, important connotations for the future chances of re-establishing any progeny in the wild. Also, if the breeding program is successful in producing an adequate number of animals, reintroduction attempts should not be deferred many generations into the future.

Some Examples of Inbreeding Depression

Let us return more specifically to the problem of inbreeding. Despite the good results reported above for some inbred lines, inbreeding is generally not so successful.

A recent study of captive ungulates revealed that in 15 of 16 species inbred young suffered a higher rate of juvenile mortality than did noninbred young (Ralls *et al.* 1979). Kear (1977) mentions several examples of undesired effects of inbreeding. Included are the relationship between inbreeding and early death in European bison, despite continuing fertility of inbred females, and high infertility in inbred male Hawaiian geese.

Reduced fertility and increased early mortality marked a sudden decrease in the number of white tigers in captivity in the late 1960s. Roychoudhury and Sankhala (1979) compiled data on the existing lineages. Inbreeding had been used to increase the number of individuals with the rare white or light coat. All white tigers in zoos were descended from one white male, captured in 1951 in the forests of Rewa, Madhya Pradesh, India. He was mated first with a normally colored tigress captured in the same forests and subsequently with a female produced in their second litter. Roychoudhury and Sankhala (1979) describe and diagram the genealogies of tigers produced from this stock at four zoological gardens in India, the United States, and England. They also

calculated the inbreeding coefficients for the matings and compiled these with data on litter sizes and mortality. Their Table 2 is reproduced here.

Table 2. Inbreeding coefficients, average size of litters, non-accidental mortality rates for different types of mating.

Types of mating			Inbreeding coefficient (*F*)	No. of litters	Total cubs	Av. size of litters	Total deaths	Non-accidental deaths	Non-accidental mortality rate
Radha	×	Mohan, Rewa	0·2500	4	14	3·50	6	4	0·2857
Mohini	×	Samson, Washington, DC	0·2500	2	5	2·50	4	3 (1–S)	0·6000
			0·2500	6	19	3·17	10	7	0·3684
Chandni	×	Himadri, Calcutta	0·3750	6	20	3·33	16	7	0·3500
Malini	×	Neeladri, Calcutta	0·3750	7	14	2·00	7	5	0·3571
Rani	×	Raja, Delhi	0·3750	7	20	2·86	13	9 (2–S)	0·4500
Homa	×	Tippu, Delhi	0·3750	2	4	2·00	4	4	1·0000
Radha	×	Raja, Delhi	0·3750	2	9	4·50	7	5	0·5556
Sukeshi	×	Mohan, Washington, DC	0·3750	5	10	2·00	8	4 (1–S)	0·4000
Chameli	×	Champak, Bristol	0·3750	3	14	4·66	11	9	0·6428
			0·3750	32	91	2·84	66	43	0·4725
Homa	×	Gautam, Delhi	0·4687	1	2	2·00	2	2	1·0000
Kesari	×	Ramana, Washington, DC	0·4062	1	4	4·00	0	0	0·0000
Mohini	×	Ramana, Washington, DC	0·4375	2	7	3·50	6	6 (1–S)	0·8571
Sashi	×	Ravi, Calcutta	0·5000	3	13	4·33	13	13	1·0000
Ashima	×	Hari, Delhi	0·5000	1	1	1·00	1	1 (1–S)	1·0000
Rani	×	Dalip, Delhi	0·5000	1	1	1·00	1	1	1·0000
Sumati	×	Akbar, Bristol	0·5000	1	1	1·00	1	1	1·0000
			0·5000	6	16	2·67	16	16	1·0000

S = Stillborn

Source: Roychoudhury and Sankhala (1979)

The authors concluded there is "a tendency for the average litter size to decrease and the early mortality rate to increase with an increase in the value of the inbreeding coefficient." Their text also records various abnormalities in morphology and behavior. While the authors recognize that "these defects and diseases might be ascribed to environmental rather than genetic causes," they feel "that at least a part of the degeneration in fitness is due to inbreeding...."

I have been referred to a 1961 paper by I. Johansson on an inbreeding experiment with ranch-bred mink but have to date been unable to obtain a copy. Roychoudhury and Sankhala (1979), however, refer to the 1968 publication of I. Johansson and J. Rendel, *Genetics and Animal Breeding*, as a source of "abundant evidence in guinea pigs, poultry, pigs and cattle that inbreeding is often accompanied by increased early mortality, decreased growth rate, reduction in litter size amd pronounced increase in sterility and in the frequency of congenital malformations."

More recently, U. S. Seal (unpubl.) analyzed in detail the Siberian tiger studbooks published by Dr. Siegfried Seifert, Director of the Leipzig Zoo. The study covers the period from 1955 through 1977. "Inbreeding in the captive population was evident as early as 1966 and has fluctuated between .100 and .180, on the average, since that time. There are 15 animals with inbreeding coefficients of .375 in the living population.... Dead animals older than one year with positive inbreeding coefficients have died at a significantly earlier age than those with zero inbreeding coefficients." Seal recognizes the potential of factors other than inbreeding to contribute to mortality. Thus, the fact that "about 35% of animals born died during the first year of life" does not necessarily result wholly from inbreeding. It is of significance to a wolf-breeding program to note the statement: "The major contributions to inbreeding in the captive population have been genetic drift and large family size of a small number of animals." The amount of inbreeding in this Siberian tiger population is not equal to that of the white tiger population studied by Roychoudhury and Sankhala (1979). Nevertheless, the possible effects of inbreeding are among the factors that suggest to Seal that "formulation of a long-term management plan will be required if this species is to survive in captivity in North America with no further recruitment from the wild."

Annual reports of the New Mexico Department of Game and Fish indicate the department imported 2.6 gemsbok. Offspring bred in captivity were first released on the White Sands Missile Range in October 1969. The resulting herd is regularly hunted and 40 licenses will be available for the December 1981 season. At this point it is doubtful whether this inbred lineage should serve as an example of a success or a possible failure. Thirty of the 40 licenses will be valid, as in the past, for oryx of either sex, but the additional ten licenses will be for a newly established bag limit of "one oryx of either sex with broken horn or horns or *horns of nontypical growth*." It is not known whether the abnormal horns result from genetic or environmental causes, but the department does wish to begin eliminating them from the breeding herd rather than chance passing deformities on to offspring.

Much of our knowledge of problems caused by inbreeding comes from the breeding of domestic dogs. Inbreeding and line breeding were tools used in the development of the various breeds, but continued inbreeding has often produced so many problems that registering institutions such as the United Kennel Club have long discouraged inbreeding "as it weakens the bloodline." Among defects that the Club attributes to inbreeding are "hip dysplasia, stiffness in joints, early blindness, hyper-activity, shyness, extreme nervousness and fits." However we judge this list of calamities, the Club's strong opinion has caused it to revise its policy as of January 1981. As quoted in the January 1981 issue of *Coonhound Bloodlines* (source of above quotes also), it states that the Club will register inbred litters, but for all inbred litters bred after January 1, 1976, the word "INBRED" will appear on the registration certificates of these dogs. The practice is intended to alert buyers and encourage them to seek nonrelated mates for the dogs.

Obviously, we cannot take lightly the possible threat posed to the Mexican wolf recovery program by the inbreeding that the paucity of available breeders may cause.

Restoration of Hybrid Vigor

Referring to the loss of genetic content in deliberate inbreeding of livestock and plants, Fisher (1965) says: "There need be no such impoverishment if many inbred lines are created simultaneously" --- a possibility not quite applicable to the Mexican wolf breeding program. Kear's statements (1977) further explain Fisher's comment: "The restoration of hybrid vigour between inbred lines seems to follow if the parent animals possess *different* deleterious recessive genes.... Different inbred lines are likely to possess different deleterious recessives and crossing these lines may once again restore vigour." Winge (1950) states that "inbreeding degeneration is of such a peculiar nature that it may be totally abolished by a single crossing with unrelated or distantly related blood.... Crossing between two degenerate inbred stocks immediately and totally abolishes degeneration if the stocks are not closely related."

The import of these statements for the Mexican wolf breeding program is one of hope if the events and chronology of the capture of parent stock should result in more than one line that is known or suspected to be touched by inbreeding. As this is written, however, we still have little concrete assurance that additional female wolves still of breeding age will be acquired to enrich the genetic diversity of the pool. Neither do we have the assurance that the breeding program, even with more females, would not be headed toward inbreeding depression, given the paucity of remaining wolves.

Contingency Breeding Proposal

If addition of more female wolves to the program is not accomplished in 1981, I find myself, as member and leader of the team appointed to recommend steps to prevent extinction of the Mexican wolf, in the uncomfortable position of having to propose certain unpopular steps, even as a minority opinion within the team. I therefore placed the following ideas before the team. Their responses will be detailed later in this paper.

If the present Mexican wolf capture and breeding program results in production from only one original female or even possibly two or three females (if more are caught), the information assembled in this paper indicates the desirability of some outbreeding. Apparently, the only potential for outbreeding lies with other stock that would otherwise not have been used in the program. A similar question exists with respect to continuation of a breeding program if no additional wild-caught females are added and Female AF005 does not produce young.

The Fish and Wildlife Service searched for wolves and records on other possible Mexican wolves in captivity, and Bogan and Mehlhop (1980) taxonomically analyzed two of these lineages. That analysis plus the existing body of records on origin of the stock seem to favor the old ASDM-GR lineage as being more closely related to *baileyi*. The objection to use of these animals in the recovery program lies with the morphological differences between these animals and wild-caught *baileyi* and the now-unresolvable question of whether these differences result from genetic causes or from the effects of captivity. (There are now additional skulls from this lineage available for analysis if enlarging the sample would be deemed beneficial.)

The young male wolves born 1978 and now at the Arizona-Sonora Desert Museum are currently unusable in the breeding program because of lack of unrelated mates within the program. Mating one or two of these males with females of the inbred ASDM-GR lineage would create no loss to or "pollution" of the present U.S.-Mexico breeding program and might restore hybrid vigor to the inbred lineage and create a group of back-up stock that might be needed to prevent the subspecies' extinction. If poor quality stock is produced, the experiment would be immediately terminated. If the stock is of suitable quality, it could be held in abeyance and used only if absolutely needed to achieve the plan's prime objective of moving the Mexican wolf from endangered to threatened status. We are at present unable to differentiate between hybridization and effects of captive breeding as the cause of morphological differences seen in the ASDM-GR lineage; the outcome of the proposed breeding might shed light on this and on the value, if any, of that lineage to the Mexican wolf recovery program. Even if *gross* abnormalities existed in the ASDM-GR lineage (and they do not), according to Benirschke (1977), "the occurence of anomalies in captive breeding need not be a direct result of inbreeding *per se*. They may have a purely environmental origin or, most likely, may be due to the interaction of a susceptible genotype (possibly reinforced by inadvertent inbreeding selection) and inimical agents in the zoo environment." This multifactorial causation can equally well apply to the less dramatic changes in phenotype seen in the ASDM-GR stock.

For some endangered species, recovery programs have already enlisted as breeding stock individuals that are not "pure" examples of the endangered species or subspecies. To save the dusky seaside sparrow from extinction, an attempt will be made to breed the remaining pair of duskies with a related subspecies. Exotic subspecies were used to reconstitute the disappearing eastern peregrine falcon. Other examples exist of increasing numbers of a desired life form by crossbreeding between subspecies and species, then increasing the desired genetic content by backcrosses to the "purest" individuals available. The experimental breeding proposed above for the Mexican wolf involves two groups so closely allied that the term "*cross*-

breeding" would be inappropriate. Reluctance to attempt to save the Mexican wolf in this fashion, *provided "purer" breeding is nonproductive*, is to me disheartening because the suspicion arises that those measures are acceptable only for life forms whose saving will cause fewer political headaches.

Both the recovery team and the Fish and Wildlife Service are, of course, acutely aware of the political complications involved in proposing any wolf reintroduction with stock that could in any way be criticized as not "pure" examples of the kind of wolf that historically existed in the release area. That is perhaps the main reason for the team's agreement with the statement in the minutes of the Mexican Wolf Workshop of February 1979: "...the FWS suggested that for the time being, captive propagation efforts use only stock captured from the wild in Mexico beginning with the seven animals captured by Mr. McBride."

The factors that are new since that meeting are the increasing age of Female AF005, her failure to date to breed in captivity, and the lack of other females wolves added to the program since 1978. For these reasons, I asked the team to set aside political considerations and provide scientific, biological reasons against or for the experimental breeding proposed. My proposal was predicated on the condition: "If addition of more female wolves to the program is not accomplished in 1981."

Team's Responses to the Proposal

I have appended the team's responses so that you will have complete information.* These responses contain optimism that more female wolves will soon be added to the program, and I try to share that optimism. Inclusion of the proposal in this paper would therefore seem unnecessary. Discussion of it is included here because some team members (Treviño, Poglayen, Nunley, and Allen) indicated they would agree to this or a similar experimental breeding proposal if Female AF005 produced no young and no new females were captured. Adequate time must be allowed for Fish and Wildlife Service's consideration of this matter and of steps to be taken if there is any possibility that the proposal would be accepted and acted on in 1982, or later. The question is also raised now because recent problems in the keeping of the ASDM-GR stock call for changes in management of that stock, but at this point the keepers hesitate to euthanize or sterilize animals that might be of some use to the recovery program. If the Fish and Wildlife Service decided now whether or not it would accept the above proposal, the team would benefit by early resolution of an otherwise time-consuming topic of discussion, and the decision would provide welcome guidance to those who hold ASDM-GR animals.

The team's responses to the proposal do seem to indicate that wolves produced through the proposed breeding might be more acceptable under the concept of saving the Mexican wolf in captivity than under the idea of saving it and restoring it in the wild. This is particularly borne out in Treviño's calling the wolves produced "man-made wolves" and Poglayen's calling them "artificial wolves." The dichotomy of goal --- saving in zoo vs. saving in wild --- has not yet been resolved and cannot be resolved by the team alone. Fish and Wildlife Service and Fauna Silvestre have that decision. The team, however, is definitely not ready to abandon the objective of restoring the Mexican wolf in the wild.

*Not included in Appendix 1.

Both Allen and Nunley mention the possibility of involving wild-caught individuals of another subspecies of *Canis lupus* in experimental breeding, as possibly preferable to the ASDM-GR lineage, which might not be "pure" although judged closest to *baileyi* by Bogan and Mehlhop (1980). I suspect this idea might be more questionable politically than the original proposal, and we must be cautious about assuming that wild-caught wolves today are necessarily "pure."

Hope for a Wolf Breeding Program, Even with a Sparse Genetic Base

Even if the above proposal is rejected and more wild Mexican wolves are soon obtained, the possibility of inbreeding may remain in the program. I think, however, we can derive hope from the examples, described earlier, of successful production from inbred lines. We can also take hope from Benirschke's statements (1977): "More frequently, however, the assumption that fecundity decreases with inbreeding is merely speculative, and the contribution made by social/environmental factors is difficult to exclude.... [In one experiment] the observed changes in reproductive fitness support the notion that selection of certain genotypes occurred, not so much as the result of inbreeding, but because of adaptation to an altered environment.... Fortunately, if an endangered species were to be reintroduced into its native environment, it is probable that the selection process would also operate in the reverse direction.... In any event, the factual data on the effects of inbreeding and possible resulting reproductive depression are very limited."

For the Mexican wolf breeding program, the recognized desirability of outbreeding should not be taken to proscribe all inbreeding at the expense of early loss of the life form.

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ADDENDUM

Subsequent to the writing of the foregoing paper, the other team member (Meritt) also indicated his agreement to the submission of the contingency breeding proposal. Also, I (Ames) have been informed that the crossbreeding proposal for the dusky seaside sparrow, referred to on page 9 of the appendix, has been abandoned.*

At the May 12-13, 1981, meeting of the Mexican Wolf Recovery Team, I made the following report to the team:

> On May 8, 1981, I met with the FWS Regional Office's assistant director, endangered species coordinator and project leader for the wolf program on the genetic base question and other recovery program matters. The final decision on the contingency breeding proposal is to be in the form of a letter from the Washington office of the U. S. Fish and Wildlife Service. The Regional Office personnel expressed the following opinions at this meeting. I report them as accurately as I can, but the final letter may incorporate different emphases:
>
> > At this time, there is no scientifically provable evidence that would either reject or rule for use of the ASDM-GR wolves as proposed. Budgetary cuts probable under the Reagan administration will likely entail cutbacks in FWS programs, and possibly staff, for endangered species and other work. Some other endangered species programs that involve captive propagation are already producing mouths to feed with uncertain prospects of reduction of captive populations through approved releases to the wild. The prospects for approval of releases of Mexican wolves are at present dim within the United States; thus, the already existing propagation program could, by itself, produce wolves impossible to release and expensive to maintain. Use of wolves other than those recently caught in Mexico, and their progeny, could be used as an argument against a proposed release. Concern was expressed about the possibility that a decision not to use the ASDM-GR wolves could be considered inconsistent with decisions already reached in other recovery programs, e. g., the eastern peregrine falcon.
>
> The decision was, thus, to reject the contingency breeding proposal. Subsequent to the meeting, it was suggested that it be stated that it "appears" the proposal will be rejected. I respect and accept the reasons offered for the rejection. An additional statement made at the meeting was to the effect that in the existing propagation effort the Fish and Wildlife Service is giving the recovery attempt its best shot and, if that failed, then the Fish and Wildlife Service had done all it could and would then, in effect, step out of the matter. The question was asked whether the state wildlife agency, or perhaps a private group, might interest itself in supporting continued existence of the ASDM-GR (and other) lineages; this seems unlikely to me considering the expense and the obstacles standing in the way of ultimate release of any of these wolves to the wild.

The attached letter dated May 22, 1981, was subsequently received. I regret it

*Correction received October 1981 says project not abandoned but would not proceed with use of endangered species funds because the hybrids would not qualify as an endangered species.

seems to address primarily a side-effect of the decision --- the obligation created by the wording of the 1979 report --- rather than the original question put to the team about the genetic base of the breeding program. Nonetheless, the decision on the contingency breeding proposal is clear.

The birth of a litter at Wild Canid Survival and Research Center and the deaths of two adult males since March 1981 bring the program's genetic base to the following, as of June 1981:

Sex	Identification Number	Est. Age June 1981	Date of Capture in Mexico or of Captive Birth
Female	AF005	9 years	Captured March 1978 (pregnant when captured)
Female	AF013	1 month	Born May 1981 to AF005
Female	AF014	1 month	Born May 1981 to AF005
Female	AF015	1 month	Born May 1981 to AF005
Male	AF002	4 years	Captured October 1977 (may be son of AF005)
Male	AF007	3 years	Born May 1978 to AF005
Male	AF008	3 years	Born May 1978 to AF005
Male	AF009	3 years	Born May 1978 to AF005
Male	AF010	3 years	Born May 1978 to AF005
Male	AF012	1 month	Born May 1981 to AF005

Unless additional males are captured in Mexico, Male AF002 is now the likely mate for Female AF005 for the 1982 breeding season. He was paired with her unproductively before, but he is now older and AF005 has now bred in captivity, in the seclusion of WCSRC. The female pups will likely be paired with their half-brothers of the 1978 litter.

The team hopes additional wolves will soon be captured to enhance the breeding program's chances of success and lessen its inbreeding potential. It is well to emphasize again that wild wolf populations apparently suffer little adverse effect from the inbreeding caused by the population's social structure. After a computer simulation of wolf pack genetics, Woolpy and Eckstrand (1979)* concluded: "The model of wolf reproduction considered here strongly implies that wolves are highly inbred.... In several generations of brother-sister and other closely related matings, wolves have shown few birth defects, However, comparable inbreeding among coyotes and dingos, which presumably have different mating systems, have shown considerable degeneration within two generations.... It would seem, then, that the natural breeding system of wolves, unlike coyotes, dingos and domestic dogs, has culled their genomes of much of the deleterious effects of inbreeding."

*Woolpy, J. H., and I. Eckstrand. 1979. Wolf pack genetics, a computer simulation with theory. *In* The behavior and ecology of wolves, E. Klinghammer, ed. Garland STPM Press, New York.

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

SE

May 22, 1981

Ms. Norma Ames, Leader
Mexican Wolf Recovery Team
c/o New Mexico Department of Game & Fish
P.O. Box 4233
Santa Fe, New Mexico 87502

Dear Ms. Ames:

As you recently pointed out, the minutes of the Mexican Wolf Workshop held at the Arizona-Sonora Desert Museum on February 6-7, 1979, report that, " . . . the FWS suggested that for the time being, captive propagation efforts use only stock captured from the wild in Mexico . . . " Although it was not fully recognized at the time, it is now apparent that this suggestion obligates institutions and individuals presently holding unconfirmed Mexican wolves to maintain the animals on the chance that changes in the direction of the current Mexican wolf captive breeding program may call for their utilization. This suggestion resulted in some confusion on the value and future of unconfirmed animals. After considerable deliberation, we are now prepared to modify the statement so that those holding unconfirmed Mexican wolves may manage the animals without fear of jeopardizing the recovery of the subspecies.

As was also discussed at the Mexican Wolf Workshop, it is our policy that an animal whose lineage cannot be traced to wild-caught Mexican stock be excluded from breeding and release programs. Therefore, we can continue the Mexican wolf captive breeding program only so long as we have confirmed breeding stock. If the only female wolf in the program (AF005) dies without producing female offspring, and no other confirmed female Mexican wolves are obtained, the U.S. Fish and Wildlife Service will have to discontinue its official involvement in the breeding program for the subspecies. If DGFS wishes to continue the program, using unconfirmed animals, we will be able to provide them with technical assistance; however, with the limited funds available and our directives under the Endangered Species Act of 1973, we cannot justify expenditures that would produce questionable animals that cannot be used for reestablishment of the subspecies. I hope this clarification of our intent relieves

institutions and individuals holding unconfirmed Mexican wolves of feeling any responsibility toward the official captive breeding program. Please let us know if further clarification is needed or if we can be of further assistance.

Sincerely yours,

Acting Gordon H. Hansen

Regional Director

cc: Direccion General de la Fauna Silvestre
Jose C. Trevino, Chihuahua City, Mexico

SOME WOLF MANAGEMENT AND HUSBANDRY GUIDELINES FOR THE HOLDING AND PROPAGATING OF MEXICAN WOLVES

These guidelines were prepared with input from all members of the Mexican Wolf Recovery Team, but were developed primarily by a committee headed by Dennis A. Meritt, Jr., with special input from Ingeborg Poglayen, Cynthia Pitsinger, José Treviño, Curtis Carley and Norma Ames. The guidelines are subject to interpretation as circumstances and facilities demand, but have been drafted with the Mexican wolf's best interests in mind. Management and husbandry decisions must consider the wolf's psychological as well as physiological needs and should be made only by those with competence and expertise in captive animal husbandry.

Part I. Guidelines for Cooperating Institutions

Housing

To provide the wolf or wolves with a safe and secure home, the enclosure should: be secure from intruders; afford privacy to the animals with as little disturbance as possible; allow the wolves enough space, and provide them with sufficient natural materials to carry out basic life functions. Such materials as soil, grass, plantings, log hollows, shelters, log piles, rocks or boulders, etc., should be included within the habitat in as natural a manner as possible.

A minimum area of 10,000 square feet is highly desirable for an adult pair with pups. Various types of barriers may be used to keep wolves in enclosures: cyclone fencing (8 feet high, 9 or 11 gauge wire, with a two-foot overhang to the inside at a 45-degree angle); moats --- dry or water filled --- plus an eight-foot Gunite wall with an overhanging lip (see Attachment No. 1). Other designs and combinations of these designs, to accomodate local conditions, are also acceptable.

To prevent wolves from digging out of fenced enclosures, the fence base should include concrete footing or a woven or welded wire apron. In some facilities, a welded wire apron attached to the fence bottom and lying horizontally atop or just under the surface soil of the enclosure's inside perimeter has been adequate to keep wolves from digging out. Safer, however, is an attached welded wire apron descending vertically from the base of the fence four or five feet into the ground. Team leader Ames uses the latter arrangement. She reports that wolves in her enclosures started a burrow about five feet from the fence line and went deep enough and far enough toward the fence that they would have tunneled under a horizontally placed apron and surfaced through the slope outside the fence.

Any housing area should include suitable shift facilities, off-display holding areas, and an area, easily accessible from the main area, for restraining

wolves when necessary. Wolves should be habituated to these areas through daily access and food incentives. These areas should be separated from the other areas by finer gauge fencing, solid partitions or double fencing. Visual separation may also be desirable in some cases. To prevent escape of frightened wolves, it is desirable that off-display areas used for restraint or capture be fully roofed.

Wolves should not be housed on concrete except as necessary for short-term veterinary treatment or other emergency. Housing on concrete often causes sore joints and other problems, and also interferes with wolves' natural activities of caching bones, scooping shallow beds, and digging deeper dens.

Wolves will dig their own burrows for denning and they may dig dens inside dirt-floored shelters. They tend to dig next to the shelter wall and often to continue digging underneath the wall. Depending on materials used in construction of shelters, it may be necessary to ensure that shelter walls are integrated so that portions of them do not collapse on wolves or wolf pups.

Two possible shelters are depicted in Attachments No. 2 and No. 3. Wolves like to lie on shelter roofs in the absence of natural hillsides or other high points found in their natural environment. Roofs should therefore be sturdy enough to bear the weight of several wolves without sagging. If nails are used to secure shelter roofs to walls, the repeated application and release of pressure as wolves get up and down will eventually cause nails to rise. Occasional checks and repairs will avoid damage to wolves' feet. Access to a shelter large enough to accommodate more than one wolf should not be limited to one very narrow opening (e. g., 1 - 1 1/2 feet wide). In the event of a dispute started inside or carried into the shelter, the "loser" can all too easily be cornered and attacked inside. A second opening or a larger single opening will help. Sturdy shelters, as those of railroad ties, can be buried under a mound of earth.

Areas of natural shade, as from trees, are desirable, and shrubs and small-diameter trees will have to be protected from wolves' biting and gnawing, which they will do to amuse themselves. If natural shade cannot be provided in the particular facility, wolves will, of course, utilize whatever shade shelters provide. In regions of bright summer sun and cold winters, strategic planning and orientation of a shelter can provide summer shade plus winter shelter and warmth plus denning area. Attachment No. 3 shows such a structure. Its walls were constructed of concrete block laid up without mortar but plastered inside and out with "Q-Bond" Cement. This allowed for quick building and adequately integrated the blocks so that there has been no cracking or collapse even though the mother wolf undermined one corner of the structure repeatedly to create her whelping den.

Water

Wolves will drink water freely, even in winter when snow is available. In regions of low winter temperatures, methods must be utilized to keep

drinking water from freezing. These should not involve any devices or arrangements that include elements or parts that wolves could reach and pull or bite on.

Wolves also enjoy going into water, and a water-filled moat will be so used. In the absence of a moat, provision of a small pool is desirable, even though it is not a necessity for the wolves' welfare. The water in pools or moats will soon be dirtied by frequent use, and algae will also grow in such pools. This can be held down by water changes, and a source of running water is beneficial. Wolves in the wild, however, are accustomed to water containing mud and algae, and the esthetics are of importance only to human viewers. Chemicals should not be added to kill algae because wolves will drink from the pools.

Diet

The use of a standardized diet by all cooperating facilities holding Mexican wolves is desirable. Nonetheless, many of the available prepared diets are suitable for Mexican wolves: dog chow (a good grade, comparable to Purina or Ken-L Ration), Zu-Preem, Central Nebraska Feline (carnivore) Diet, meat mixture (50% moistened dog chow + 50% lean red ground meat), and carnivore mix. The husbandry committee is inclined to recommend that dry dog chow be soaked before feeding and that feeding of dry food be avoided. The recommendation is based primarily on three known dry-chow-related cases of stomach torsion in captive wolves. Wild Canid Survival and Research Center, however, has long fed dry chow to wolves without incident, and stomach torsion is not reported to be a common occurrence among dogs. The matter is therefore open to further findings, although we would hope that any future rule against dry chow would not derive from further losses to the Mexican wolf recovery program.

The Arizona-Sonora Desert Museum (ASDM) feeds two pounds of Purina Dog Chow/ Feline Diet per day per wolf. The ratio of moistened dog chow to feline diet is 2:1, well mixed. This is a maintenance amount of food and has proved both acceptable and nutritious. ASDM also feeds chicken necks, chicken backs and/or New York dressed chicken once a week. The two pounds per wolf per day fed by ASDM is in keeping, for the Mexican wolf's size, with Mech's (*The Wolf*, 1970, Natural History Press, Garden City, publishers) estimate of .031 pound food per pound of wolf, daily, as a maintenance diet for caged wolves. The Wild Canid Survival and Research Center also provides supplemental feedings of chicken backs and necks, as does Ames for her wolves. This is a good way to provide additional calcium. Wolves seem to require a higher ratio of calcium to phosphorus than is provided by many commercial diets.

Somewhat larger amounts may have to be fed, according to the location and nature of a facility. Cold and increased activity, for example, will increase food requirements. Ames' wolves are in a cooler climate than that at ASDM. Cool nights year-round plus cold, snowy winters are no doubt factors in the rather large amount of strenuous running and playing that Ames' wolves do. She feeds Kal-Kan plus chicken backs and necks daily, an average 3.25 to 3.5 pounds daily per wolf, dog food and chicken combined (Kal-Kan would be an extravagant zoo diet, and it is named here solely to provide basis for any comparisons of nutrient contents.). Mech (*loc. cit.*) estimated

that the wild northern wolves needed two to four times the maintenance requirements that had been derived from studies of caged wolves. Ames also notes that appetites of her captive wolves increase during periods when coat changes (shedding and regrowth) are most noticeable.

Fresh, large, joint or long bones may be provided on an occasional basis, free choice. There is some evidence that wolves provided with bones (or whole large carcasses) on an almost daily basis tend to exhibit less of the weakening of cranial muscle and bone that may occur with some "artificial" diets. Prevention of such weakening could prove of value in re-establishment in the wild of released captive wolves.

Pregnant or lactating bitches will require dietary adjustments, as will developing and older animals. The need for additional calcium in pregnancy and lactation has been demonstrated in related wild canids. Mech (*loc. cit.*) feels that growing wolves needtwo to three times as much food per pound as do adults. Barnum *et al.* (1979) suspect that National Research Council requirements for dogs provide inadequate amounts of protein and fat for captive coyote pups, and a similar situation likely exists for captive wolf pups. They recommend diets supplying a minimum of 30 percent fat and 20 percent protein (Barnum, D. A., J. S. Green, and J. T. Flinders. 1979. Nutritional levels and growth rates of hand-reared coyote pups. Jour. Mammal. 60(4): 820-823).

While different cooperating facilities may use different diets, it is advisable that any wolf transferred from one facility to another receive, during its first week at the new facility, the diet it was accustomed to receive at its former residence. This will lessen the trauma of adjustment and should not be difficult for the facility to provide, especially since a transferred wolf is normally kept separated from other wolves at the new facility for an initial period of adjustment and observation.

Feeding six days a week and fasting on the seventh is a beneficial and acceptable practice. Any medication that must be given on a routine basis, such as worm medication, may be offered after the fast and is usually accepted in a small amount of food. For this procedure, the animals should be separated to avoid the possible intake of a double dose by a dominant animal.

The needs of the Mexican wolf must not only be assessed and met as a subspecies, but also as individual animals. Modifications will be necessary with this individual in mind. For example, in a large group of wolves, attempts may have to be made to ensure that all receive adequate nutrition. The use of multiple feeding stations, the controlled distribution of food, etc. may be necessary.

Sanitation

Zoological procedures will vary from facility to facility but basically

involve daily enclosure or cage cleanup by raking, shoveling or hosing and by washing and cleaning food and water containers. A facility's normal procedures should be routinely followed, and facilities that house wolves will be evaluated on an individual basis in this area. Removal of fecal material, area cleanup, landscape maintenance, etc., should follow established and acceptable procedures. All cleaning aids, disinfectants, and chemical agents must be safe, nontoxic and biodegradable.

Daily Routine

Captive animals react positively to sympathetic and responsive personnel. The importance of a routine, of moving slowly and deliberately, of minimizing noise and traffic cannot be stressed too strongly. Skilled personnel should be carefully chosen with their individual capabilities, interests and special talents in mind. Those working with wolves should ideally have a basic understanding of the wolf's natural history and have a sincere interest in the animals themselves. Personnel assigned to wolf care should be those used to and familiar to the animals themselves. On the other hand, personnel caring for wolves should not lose sight of the objectives of the Mexican wolf recovery program and should make every effort not to make pets of captive wolves.

Observations

Daily reports by animal care personnel and staff should include written material addressing general condition, health, food consumption, bowel habits, activity cycle and the interactions of the animals (a sample report form appears as Attachment No. 4). A photographic record of wolves should be maintained, not only as documentation but also to assist identification and record-keeping. Veterinary inspection should be made visually on a routine basis. Animal care staff and veterinary staff must coordinate all intended restraint, medication, testing, animal introduction, etc., at all times in a well-planned manner. Wolves should be handled only when necessary and only by trained, experienced personnel. In any nonemergency handling procedure, prior approval is required from the U. S. Fish and Wildlife Service and/or Dirección General de la Fauna Silvestre.

Specimen Collection

Procedures for collection and disposition of specimens from deceased and living wolves will be specified in the agreement signed by the U. S. Fish and Wildlife Service with the cooperating facility or otherwise detailed in letters of instruction from the Fish and Wildlife Service. The Fish and Wildlife Service will have coordinated these instructions with the Dirección General de la Fauna Silvestre and obtained that agency's approval of the indicated disposition of all specimens. Collection of specimens and data (blood, tissue samples, size and weight measurements, X-rays, etc.) will be coordinated by the Fish and Wildlife Service to meet needs of the recovery program or approved research projects.

Data on physiological and anatomical norms should be collected at a central point and made available, as collected, to all appropriate cooperating facilities, agencies and individuals, including members of the Mexican Wolf Recovery Team.

Shipping

Wolves will be moved from one location to another only on orders of the Fish and Wildlife Service with the consent of the Dirección General de la Fauna Silvestre. All transport of wolves should be planned well in advance and instructions should be in writing. Shipping containers must meet or exceed requirements of USDA and IATA (International Air Transportation Association). All federal requirements must be met concerning permits, health certificates, transport documents, labeling of containers and attachment of papers. The safety and comfort of the wolf must be ensured, prior to and during transport, and routing and all shipping conditions must be made known to and approved by Fish and Wildlife Service prior to shipment.

Veterinary Care

Guidelines have been developed by Curtis J. Carley, with input from Dr. Long of Winnie, Texas, and Dr. Jones of Tacoma, Washington, for veterinary care of captive wolves in the red wolf recovery program. They are recommended for use in the Mexican wolf recovery program and are appended as Attachment No. 5. In addition, cooperating facilities are referred to pages 613-617 and 626-628 of *Zoo and Wild Animal Medicine*, Murray E. Fowler, editor-in-chief, 1978, W. B. Saunders Co., Philadelphia, publishers.

Propagation

While the Mexican Wolf Recovery Team subscribes to the philosophy expressed in the first paragraph of the veterinary care guidelines included as Attachment No. 5, now, in early 1981, the Mexican wolf captive breeding program is at so low an ebb that we must recommend that every attempt be made to ensure the survival of all pups born, at least until the recovery program includes adequate numbers of female and male wolves to warrant any risk of losing pups. At this stage in the Mexican wolf recovery program, any negative effects of hand-rearing are of minor concern in the face of the need for pure numbers of animals to ensure continuation of the propagation effort. Any resultant socialization to humans can be counteracted over the course of several captive-bred generations.

For hand-raised pups fed milk-replacement diets, records should be kept on the specific formula used and on any development of lens opacities and of remission of such conditions after weaning to sold feeds. Potential value of this

information to any wolf recovery program involving captive propagation is indicated by: Vainisi, S. J., H. F. Edelhauser, E. D. Wolf, E. Cotlier, and F. Reeser. 1980. Nutritional cataracts in timber wolves. *In* Proceedings of the First Annual Dr. Scholl Nutrition Conference.

Part 2. Selection and Approval of Facilities

Persons empowered to screen, select and approve facilities for the holding and/or propagation of wolves in the Mexican wolf recovery program should seek those facilities that can most completely provide the accommodations and care described above. An advertisement for zoological institutions interested in serving as holding facilities for male Mexican wolves was placed in a 1980 issue of the *AAZPA Newsletter* and only two institutions responded. This may indicate a lack of interest in committing space and funds to what would have likely been --- at least at that stage --- a nonpermanent exhibit with rather "fussy" requirements. It could indicate, however, that appropriate facilities may be difficult to locate for use of the Mexican wolf recovery program.

Part 3. Natural-Area Holding/Breeding Enclosure

The natural-area holding/breeding enclosure should meet all the needs of captive wolves indicated in the various sections of Part I of this appendix. The housing needs should be met, however, through utilization of natural features of the area, whenever possible. Thus, artificial shelters will likely not be needed for a large enclosure in a well-chosen area of habitat. Any facilities for veterinary care or other temporary holding of wolves should be separate and considerably apart from the enclosure, which should remain as human-free as possible.

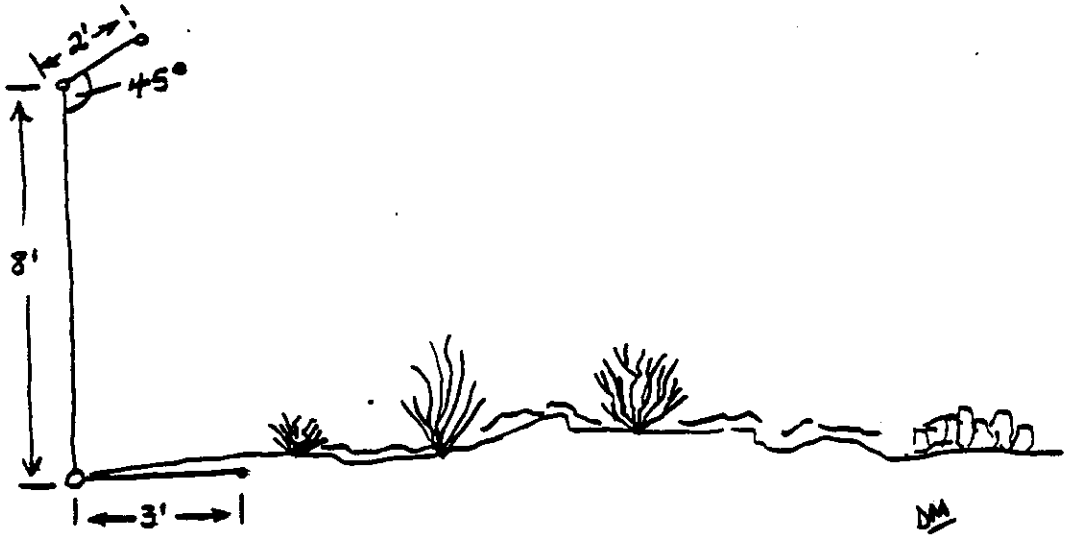
A corner of the enclosure, fenced off and provided with access gates operable from outside, can be used for a feeding area and, thus, for entrapment of wolves that must be examined or removed from the enclosure. If live prey is to be introduced into the enclosure, this should be done directly into the main portion of the enclosure.

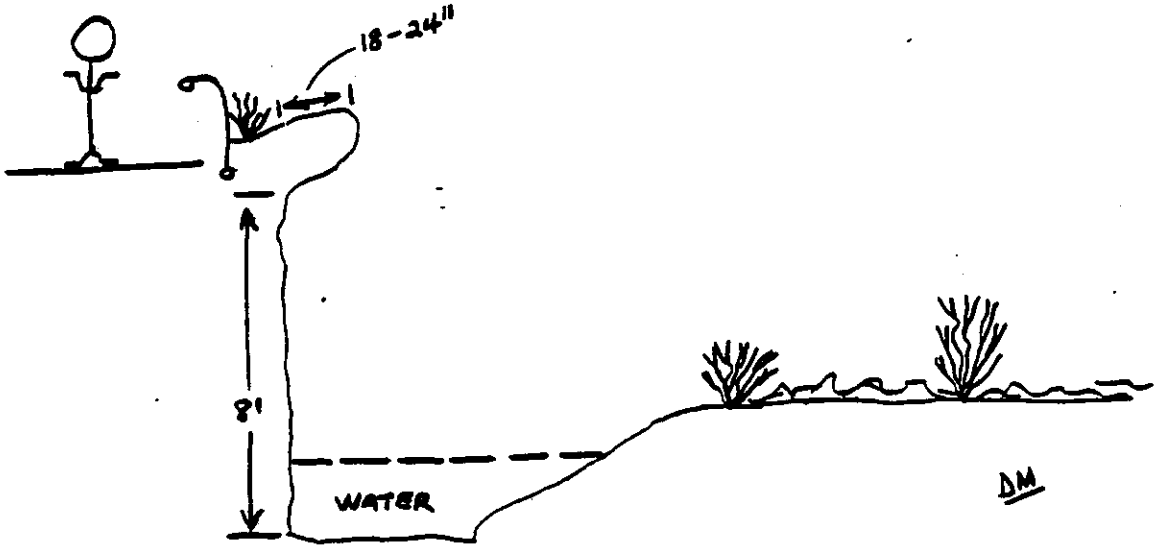
Inclusion of a natural water source within the enclosure is highly desirable. If this cannot be accomplished, a small catchment pool can be constructed in the enclosure, to be filled by pipe or channel leading from outside the enclosure.

An enclosure of adequate size and vegetative cover is unlikely to require sanitizing, except perhaps after wolves have been released. Cleanup would, in fact, provide more human presence than the holding-breeding-release scenario calls for.

Lastly, the nature and shape of the enclosure's construction may be influenced by the possibility that its inhabitants may eventually be released to the wild through enactment of the scenario proposed in the plan's narrative.

PERIMETER BARRIER





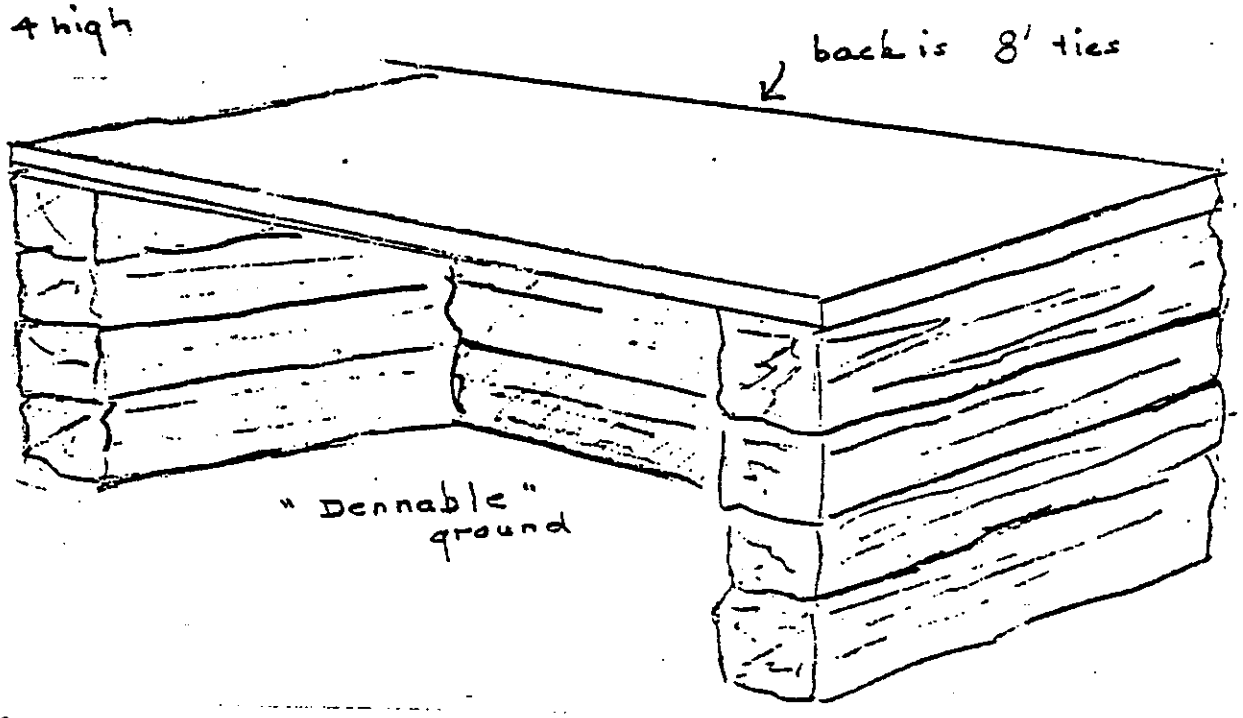
APPENDIX II

Attachment No. 2

SUGGESTED OPEN WOLF SHELTER

Can be
Cut to
4' railroad ties

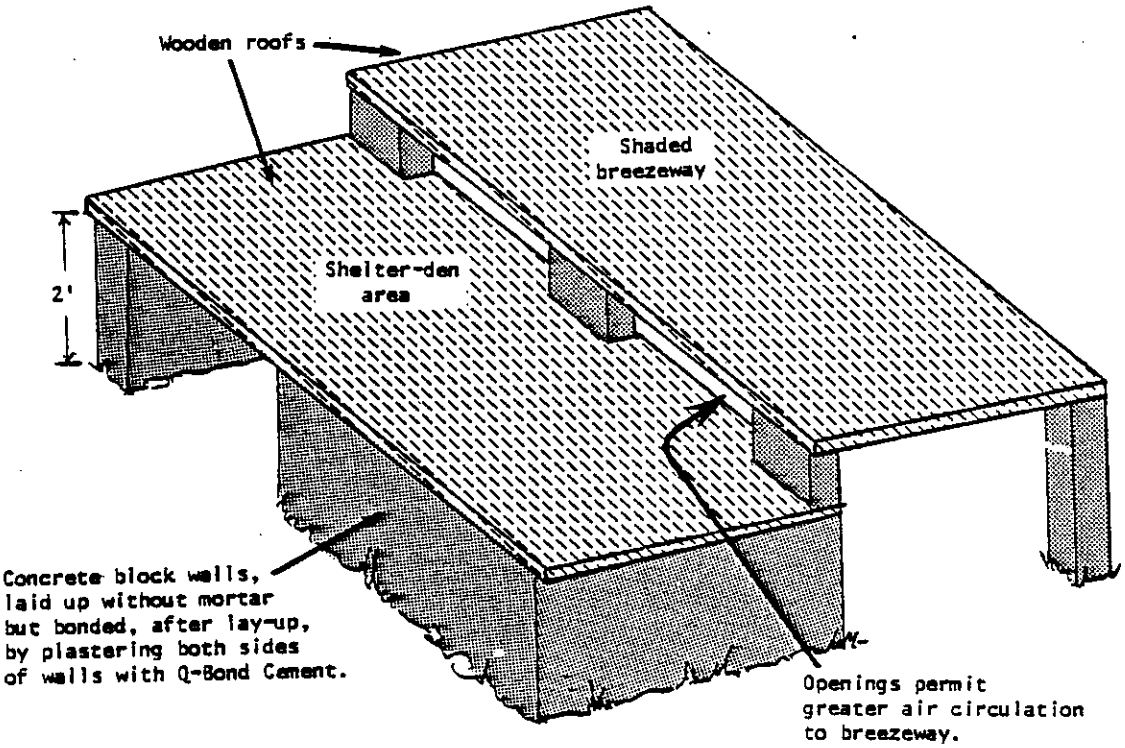
stacked
4 high

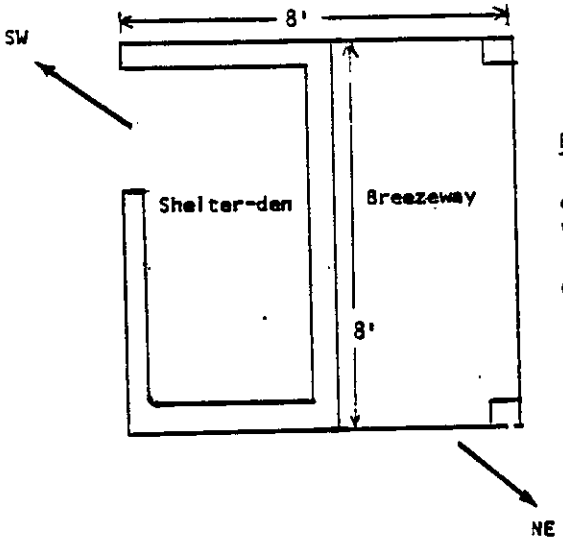


Top is wood for good footing when wolves jump up.

Sketch by C. Pitsinger WCSRC 7-'80

SUGGESTED SHELTER FOR AREA WITH LOW WINTER AND HIGH SUMMER TEMPERATURES





Floor plan (reduced) to show orientation

In winter, low afternoon sun warms interior of shelter-den area. Block walls retain warmth.

In the facility in which this shelter is used, winter winds and summer breezes come from the north.

Wolves lie in shade of breezeway in summer and curl up in the shelter-den during winter storms and winter nights. They enjoy lying atop the shelter and breezeway on pleasant days and warm nights.

N. Ames

DAILY KEEPER REPORT

Attachment No. 4

SECTION:_____ SENIOR KEEPER:_____ DATE:_____

Report the following and check item(s) reporting:

(a) Any changes in census (Purchases, Deaths, Donations, Hatchings, etc).

(b) Sick or Injured animals (Veterinary treatments).

(c) Behavioral observations (Courtship, Egg-laying, Aggression, Breeding, Shedding, etc). Include identification such as ear-tag number and house name band number when possible.

(d) Changes in diets or amounts consumed.

(e) Additional comments (Animals moved, Jobs completed, etc).

(use other side if necessary)

GUIDELINES FOR THE VETERINARY CARE OF CAPTIVE WOLVES BEING RAISED FOR REESTABLISHMENT IN THE WILD

In the interest of reducing interference with "natural selection" while rearing wolf pups in captivity and to avoid conflicts with the objective of producing "wild wolves" suitable for reestablishment programs, we have found it necessary to avoid hand-rearing pups or taking other extraodinary measures to increase survival rates, unless such care is absolutely necessary for the survival of the species. Our concerns are that taking such measures may result in the survival of "substandard" animals that do not represent the wild species, and that they or their offspring may not survive the rigors of nature once reintroduced to the wild. However, the confinement of captivity tends to increase the exposure of the animals to parasites and disease; therefore, some veterinary care is required to achieve litter survival rates that would be expected to occur in the wild. The care involves treatments to reduce parasite infestations and inocculations to prevent disease. Based on our experiences we recommend the following:

SEDATION

EXTREME CAUTION SHOULD BE USED WHEN SEDATING WOLVES. Partially due to the fact that the animals are not accustomed to human contact, they are easily stressed. Due to stress, in combination with other factors, we have found that wolves often respond differently than domestic canines to standard canine sedatives. TO AVOID OVER-SEDATION IT IS OFTEN NECESSARY TO SIGNIFICANTLY REDUCE THE SEDATIVE DOSE THAT WOULD BE GIVEN A DOMESTIC CANINE OF SIMILAR SIZE.

PARASITES

Internal - Adult animals should not be handled any more than necessary due to the risk of injury, shock, and/or overheating during capture. Intestinal parasite infestations should be monitored by obtaining fecal samples from the animal's pen. Whenever intestinal parasites are noted, the adult animal can be treated with an appropriate anthelmintic, such as Telmintic or Telmin Powder (Pitman-Moore) mixed in its food until such time as the fecal samples appear to be free of parasites. If the animal is to be handled for other reasons, such as transport to another pen, it can be given a D.N.P. (Amer. Cyanamid) injection or oral treatments such as Telmintic or Telmin Powder, Dizan (Elanco), Nemex Liquid (Pfizer), or Piperazine Water Wormer if the need is indicated through fecal examinations. Intestinal parasite infestations should particularly be monitored and treated just prior to breeding in February and March to enhance the survival of pups in the spring. Thus far, we have not experienced significant infestations of tapeworms; however, it is anticipated that any standard canine wormer should be effective on these parasites without undue hazard to the animal being treated.

Since young pups are quite susceptable to intestinal parasites, and we have noted several deaths attributable to such parasites, we recommend a worming program for all pups at an early age. The recommended procedure is to mix a "20 pound size" package of Telmintic Powder (Pitman-Moore) with 1 ounce of water to be administered orally at a rate of 1 1/2 cc per pound of body weight for three consecutive days starting at 10 days of age. In some instances it may be necessary to initiate this program as early as 3 days of age. The pups should be treated individually in the den and immediately returned to their "nest" cavity after each treatment. As the pups reach weaning age, injectable D.N.P. (Amer. Cyanamid), Dizan (Elanco), Nemex Liquid (Pfizer), and Piperazine Water Wormer may be used as fecal exams warrant.

All wolves will be checked for the presence of heartworm before being shipped to breeding facilities. Due to the rarity of the animal with which we are working, and the risks involved with treatment, we do not recommend treatment of infestations of adult heartworms. If it is certain, as a result of extensive multiple tests, that the animal is not infested with heartworm, we recommend that a heartworm preventive be included in its food in areas of the country where this parasite is known to exist. In areas of the country where heartworm is known to exist, we also recommend that a heartworm preventive be included in the diet of young pups if they have been separated from their parents who may harbor the parasite. Pups are generally separated from their parents at six months of age so as not to interfere with the next breeding season.

External - Ticks and fleas are generally not a serious problem on wolves in good health. Should such parasites become a problem, we recommend the dusting of den and rest areas with standard canine tick and flea powders. Although mange has not been a problem in captive animals, should it occur, we recommend the capture of the infested animal and treatment with Paramite Dip (Vet-Kem Lab). Animals closely associated with the infested animal should also be treated.

VACCINES

When handled, adult wolves should be inoculated against Distemper, Hepatitis, Leptospirosis, and Parainfluenze using standard canine vaccines. They should be inoculated against rabies with a 3-year vaccine such as MLV Rabies Vaccine (Norden) or killed virus Trimune (Fort Dodge).

Young pups should be inoculated against Distemper, Hepatitis, Leptospirosis, and Parainfluenza with standard canine vaccines at 8, 10, and 12 weeks of age or 9 and 12 weeks of age. After 4 months of age, they should be inoculated with MLV Rabies Vaccine (Norden) or Trimune (Fort Dodge) for rabies protection. All pups should be inoculated with killed Parvocine (Dellon) at 8, 10, and 12 weeks of age or 9 and 12 weeks of age as recommended by current literature. Parvocine may be given as early as 3 weeks of age if warranted by the eminent threat of the disease.

FOOT SORES

On a number of occasions we have encountered very young pups with localized foot pad sores and/or pustules on their undersides. It is thought that such sores may be the result of Staphylococcus infections. They have been effectively treated with Panalog (Squibb), applied topically, and oral treatments of Linococin Aquadrops (Upjohn) at a rate of 24 mg per pound of body weight. Treatment is made twice daily until the condition improves, usually in 7-10 days.

UTERINE INFECTION

On several occasions, as indicated by vaginal spotting, we have observed apparent uterine infections shortly after whelping. These infections have been effectively treated with standard canine doses of Amoxicillin (Beecham) given twice daily for 7-10 days. To avoid handling the nursing female, we have found it effective to incorporate the medication in meat placed in a location where she will find it before her mate does.

Prepared by C. J. Carley
8/20/80

TECHNICAL REVIEW

For the technical review, comments were received from:

Ed Schmitt, Chairman, AAZPA Wildlife Conservation and Management Committee
Dan Davis, Director, The Arizona-Sonora Desert Museum
Ralph Bailey, Team Leader, Eastern Timber Wolf Recovery Team
State Director, Arizona State Office, U. S. Bureau of Land Management
Dennis Flath, Northern Rocky Mountain Wolf Recovery Team
Jerry L. Burton, Asst. Area Manager, U. S. Fish and Wildlife Service, Phoenix
James C. Overbay, Deputy Regional Forester, U. S. Forest Service, Region 3
Carl R. Gustavson, Ph.D., Assoc. Prof., North Dakota State University
Harold F. Olson, Director, New Mexico Department of Game and Fish
Ronald N. Nowak, Ph.D., Staff Specialist, Office of Endangered Species, FWS, Washington
George B. Rabb, Ph.D., Director, Brookfield Zoo, Chicago
Rolf O. Peterson, Asst. Prof., Michigan Technological University
Mark S. Rich, Curator of Mammals, San Diego Zoo
Lyle K. Sowls, Ph.D., Unit Leader, Arizona Cooperative Wildlife Research Unit, Tucson
James F. Scudday, Ph.D., Prof. of Biology, Sul Ross State University
Murray L. Johnson, University of Puget Sound
Henry M. Zeller, Secy., New Mexico Natural History Institute
National Wildlife Federation, Washington, D. C. (J. Scott Feierabend and Sharon E. Dean)
David W. Peterson, Leader, Red Wolf Recovery Team
Harry Frank, Ph.D., Assoc. Prof., The University of Michigan-Flint
Harold O'Connor, Depauty Associate Director, FWS, Washington; with attachments from Ecological Effects Branch, Environmental Protection Agency (Elizabeth E. Zucker and Russel T. Farringer)
D. G. Kleiman, Head, Dept. of Zoological Research, National Zoological Park, Smithsonian Institution

The agency-review draft now reflects corrections in typographical errors to which the team's attention was called, as well as in information on the dusky seaside sparrow breeding proposal.

A few comments indicated misinterpretations of the team's intent, caused in part by lack of full information or clarity in the original presentation. The particular points have been rewritten to clarify the matters and make the intent clearer.

Some comments were in the nature of informative expansions on points in the plan. Most of these covered material of which the team was already aware and had considered in the plan's development. The plan did not contain all such elucidations simply because it is not intended to be a comprehensive treatise. The team is grateful for the interest and informative comments and suggested sources of additional information. These will be utilized and taken into consideration at the appropriate places in the recovery program. Such comments generally required no amendment of the plan, but it may be of interest here to note that they included emphatic support for:

Active, early educational efforts;
Study and implementation of nonlethal techniques for preventing and controlling livestock damage;
Proceeding with present breeding program despite its limited genetic base (the team's concerns about inbreeding were, however, general approved as justified);
Stimulation of interest and support in Mexico;
Adopting advantages offered by lumping closely related subspecies;
Isolating captive wolves in breeding program from humans as much as possible;
Seeking ways to utilize offers of assistance from interested public in areas of funding, planning, provision of land and actual operations.

Also included were comments based on the particular reviewer's pessimistic or optimistic outlook for the recovery effort. These require no amendment of the plan. Some of them revolve around the idea of retaining wolves in large enclosures, in part for the purpose of buying time for the Mexican wolf and with the hope that resistance to release proposals might be less some time in the future. Negative and positive comments were approximately equal in number, and the team is not inclined to change the thoughts it expressed under "Restoration in the Wild Versus Preservation in Captivity."

Other comments are summarized below, with the team's responses.

Area of Comment	Number of Comments	Team's Response
Quantification of self-sustaining population desirable (quantified delisting criteria needed).	3	Matter now addressed in revised prime objective.
Delisting not justified on basis of establishment of two populations.	1	Team agrees; prime objective revised.
Releases within U.S. not addressed specifically; agencies within U.S. not able to assess their involvement	3	The problem of Mexico's agreement to use of program wolves in releases in U. S. has now been specifically addressed. In the agency-review draft, the matter is detailed in the closing paragraphs of "Release Areas - Habitat Considerations."
Contingency breeding proposal	3 for, 2 against	Team was interested in the comments, but, as stated in plan, the matter is now consider a dead issue, although it was recorded in the plan as part of the pertinent deliberations. One commenter strongly recommended an auxiliary breeding program using the ASDM-GR lineage and release-oriented research using these animals - supported by nongovernmental funds.
Maintenance of maximum genetic diversity should be more strongly emphasized.	4	Team agrees; Appendix I had indicated this, but specific emphasis has been added, including rewrite of 316-7.

Area of Comment	Number of Comments	Team's Response
Plan should include environmental assessment of impacts of wolf releases, especially on public lands.	1	Already in plan: 323-2.
Item 4 of Step-down Plan should include declaration of subspecies' extinction in wild.	1	Agreed; addition made.
Any needed control of released wolves should be done under endangered species permit rather than by classifications of wolves and zones that permit management.	2	Team feels permit system might delay control action and thereby provoke added resistance to recovery program. If the zone system fails where it is now applied, amendment of this plan would be considered.
Wolves emigrating from release areas should be trapped and returned to enclosures.	1	No wolves would be released until adequate numbers in breeding program permitted risk of loss of some in release projects. While efforts would be made to recover emigrant wolves, such operations may not be feasible in Mexican wolf range. Emigration could contribute to further colonization, also. Another reviewer comments that "translocatio of wolves that wander out of the protected zones...is probably not a practical alternative."
Plan is not concise (as directed by FWS guidelines)	2	An abbreviated plan would omit ideas and information not recorded elsewhere and of probable value to personnel conducting recovery actions. One reviewer making this comment added that the extensive information was valuable in explaining decisions made in the plan's formulation. Another commended the team on inclusion of Appendix I informatic
Plan bases some recommendations on theories; another reviewer expresses personal doubt about one theory.	1	While theories' validity can be tested only by scientific study of Mexican wolves in the wild (no opporunity at present for this), the theories are based on at least some real observations and represent factors of importance to progress of recovery effort. They must therefore be included as caveats to recovery program personnel.

Area of Comment	Number of Comments	Team's Response
Plan should include guidelines for livestock management.	1	Suggestions for management practices to minimize conflicts will be improved by ongoing research and will be developed and recommended as program proceeds through EIS, specific release proposals, and educational efforts, including those involving livestock industry.
A funded program is essential for prompt compensation of livestock losses.	2	The team asks only consideration of the practice and application if it is deemed good at the time. Compensation for damages by game species has been abolished in all states able to effect such abolishment. The system can be financially crippling and is subject to error and fraud. Better compensatory systems should be sought.
Wolves to be released should be aversively conditioned to feeding on sheep and cattle.	1	Specific mention of this and other techniques was unintentionally omitted. 344-124 added.
27 should include establishment of protective reserves in former range of Mexican wolf, as well as in existing range.	1	Steps in Section 2 have to do only with protection of any wolves remaining in wild. Section 3 pertains to reintroduced wolves; see 323-3.
Land should be acquired to facilitate restriction of development in areas of Mexican wolf habitat.	1	Livestock and agricultural interests in the West already strongly oppose land acquisition for benefit of any wildlife, even game and nonendangered kinds.
Captive breeding should be done in enclosures in proposed release areas.	2	This would also be the team's preference, but it has not been possible in progress of the breeding program since 1978, and present stages of the breeding program likewise cannot wait until release areas are selected.
32 (selection of release areas) should precede 311-3 (construction of enclosures in areas suitable as release areas).	1	Logically, yes, but numbering in Section 3 does not always indicate chronological order; many steps, necessarily numbered separately, can proceed simultaneously; 31 and 32 are examples. Team had to choose between flow-chart style (chronological) used in some plans and step-down style called for in FWS guidelines, in which combination of lower-echelon steps produces accomplishment of upper-echelon ones.

Area of Comment	Number of Comments	Team's Response
Team should establish law enforcement programs including patrol provisions and definitions of violations and penalties.	1	Federal and state laws and enforcement procedures are already specific. Team has no such authority.
Rewards should be paid for information leading to arrest and prosecution of persons killing Mexican wolves.	1	In U. S., such reward programs already exist to assist in enforcement of already-specific laws. Establishment of such programs in Mexico is improbable.
Plan should detail strategies for meeting captive wolves' social needs.	1	316-2, Appendix II, and scenario outlined in "Holding-Breeding Enclosures" already provide opportunity for the sequences recommended by the reviewer.
Plan does not list prey of Mexican wolves.	1	Section added to plan to clarify this.
Not all remaining wild wolves should be captured if some remain where they are not in immediate jeopardy.	1	It is not likely that any wolves remain in such fortunate circumstances. It is also not likely that all remaining wolves can actually be taken. 312-2 amended anyway to avoid such an absolute directive.
344-21 and 344-22 should also be included in Section 2 and should not be associated only with the release program.	1	There is too little likelihood of wolves remaining in the wild for Mexico to commit funds to these steps as pre-propagation and pre-release programs.
Specific feedings recommendations were received.	1	Incorporated in Appendix II, along with other new information coming to team's attention from other sources.
Criteria should be established for distinguishing between intentional and accidental violations (212-2).	1	Team feels that law-enforcement officers are experienced in such discretionary matters.
Release site selection should address existing predator control in and near area.	1	See 322-2 and 344-3.
Criteria should be established for determining when a wolf should be captured because it is jeopardized by otherwise legal predator control or trapping.	1	Since formulation of plan began, it becomes increasingly true that where w d wolves still exist is Mexico. A wolf in Mexico can be both legally protected and in dire jeopardy. 222 at least gives involved personnel of FWS and DGFS needed options for action.

Area of Comment	Number of Comments	Team's Response
Criteria should be established for judging when a wolf is unsuitable for use in the program.	1	316-7 reworded.
Experimental population classification should be addressed as an alternative.	1	323-31 reworded.
Plan should include step-down outline and narrative.	1	Present; see table of contents.
222 and 344-3 should include protection of wolves from secondary poisoning from rodenticides.	1	Added in 344-3; likely no longer of value in 222 (nor enforceable in Mexico).

APPENDIX IV

AGENCY REVIEW

Ten responses were received. The letters are reproduced on the following pages. A few require specific responses.

Harold O'Connor, Deputy Associate Director, U. S. Fish and Wildlife Service: The page-61 item referred to was a result of items having been typed in the wrong column. It is corrected in the present draft.

Larry L. Woodard, Associate State Director, Bureau of Land Management, New Mexico: The concerns noted in this letter are indeed valid ones. Those pertinent to any specific release proposal will of course be dealt with in detail during the requisite procedures to present the proposal and obtain approval or disapproval of it. In addition, the more general concerns will necessarily be handled in greater detail in subsequent updatings of the plan. The plan's present segment runs only to September 30, 1984. For realistic release proposals plus adequate stock to ensure against extinction, the captive breeding program must build to considerably more than the ten wolves now held in early May 1982.

Barry W. Welch, Acting Area Director, Bureau of Indian Affairs, Albuquerque Area: The team carefully considered the option of trying to protect the Mexican wolves remaining in the wild, as opposed to increasing the number of Mexican wolves in a captive breeding program. For reasons stated in the plan, the team feels that option would not prevent extinction of the subspecies. In addition, the plan recognizes that release proposals may not be approved and provides for preservation of captive populations in that event.

Charles D. Travis, Executive Director, Texas Parks and Wildlife Department: As the recovery program now stands, there is a de facto communications net. Facilities involved in the captive breeding program operate under agreements with the Fish and Wildlife Service Regional Office, Albuquerque, and report to and consult with that office. The Fish and Wildlife Service's Project A-1, Management of Threatened and Endangered Species, has two subproject leaders, one for Mexico and one for the United States, for Subproject A-1.1, Mexican Wolf. The U. S. leader is located in the Regional Office, and that office serves as the focus for information and decisions on cooperative actions involving Mexico and the Mexican wolf. The Mexican subproject leader also serves on the recovery team. The recovery team leader receives information from and is consulted by the subproject leaders and by the breeding program facilities and interfaces with the team. The American Association of Zoological Parks and Aquariums is represented on the recovery team and also communicates directly with the Fish and Wildlife Service Regional Office by reason of its involvement with captive breeding programs of other endangered and threatened species for which the Regional Office has responsibilities.

On important international decisions relating to the recovery program, occasional correspondence is handled formally between the U. S. Fish and Wildlife Service, Washington, and the Dirección General de la Fauna Silvestre, Mexico City. This is, however, correspondence referred from or to the Regional Office, and the Regional Office therefore continues to be the focus of

information exchange. Decisions affecting this recovery program are also made at meetings of the U.S.A.-Mexico Joint Committee on Wildlife Conservation. Again, the Fish and Wildlife Service Regional Office is involved, as is the Secretary of the New Mexico Department of Natural Resources, again providing routes for the flow of communications.

Future proposals for releases of Mexican wolves within the United States will involve other agencies. The Fish and Wildlife Service, through its Regional Office, will remain the agency responsible for formulation of the proposals, for NEPA compliance, and for conduct of any approved releases. Under existing legal frameworks, management authority for released wolves will remain with the Fish and Wildlife Service in cooperation with the states involved. It is highly unlikely that this recovery program would produce such numbers of Mexican wolves in the wild within the United States as to warrant release of management authority by the Fish and Wildlife Service to the states involved. The Fish and Wildlife Service Regional Office therefore continues to remain the focus of the communications net for the foreseeable future.

With respect to programs that may develop within Mexico for captive breeding and releases of Mexican wolves, decisions will be the prerogative of the Dirección General de la Fauna Silvestre. For communications about such decisions and actions, the United States portion of the recovery effort will be dependent upon the continuation and the efficacy of cooperative recovery and research projects and the offices of the U.S.A.-Mexico Joint Committee on Wildlife Conservation. So long as the recovery team remains a functioning body, it also will serve as part of this communications net.

Lester K. Rosenkrance, District Manager, BLM, Safford: The team recognizes that the regulatory mechanisms proposed in 323-4 and 344-122 may not exist in specific cases and therefore suggests consideration of establishment of such mechanisms. The team agrees that there will be opposition to 324-1. We, and other wolf recovery teams, feel that extent of the opposition must be determined through open proposals for such actions. 344-124 was poorly worded and has been corrected in the present draft.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

Sent. Sec. 7 — Admin. ACTION — FILE Mexican Wolf

ADDRESS ONLY THE DIRECTOR, FISH AND WILDLIFE SERVICE

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In Reply Refer To:
FWS/OES

APR 27 1982

Memorandum

To: Regional Director, Region 2 (ARD/AFF)
Deputy Associate
From: Director

Subject: Review of the Mexican Wolf Recovery Plan - Agency Draft

We have reviewed the subject plan and wish to commend the Mexican Wolf Recovery Team for the thoroughness with which this plan has been developed. We have only one editorial comment. Add task priorities for the tasks identified on page 61.

Please submit one copy of the final draft for the Director's approval and two signature pages.

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FWS REG 2
OFFICE OF THE
REGIONAL DIRECTOR

MAY 4 1982

To team 5/3/82 SE

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
NEW MEXICO STATE OFFICE
P.O. BOX 1449
SANTA FE, NEW MEXICO 87501

IN REPLY REFER TO

APR 21 1982

Memorandum

To: Regional Director, Region 2, USFWS, Albuquerque, NM

From: Associate State Director, BLM, Santa Fe, NM

Subject: Agency Review Draft - Mexican Wolf Recovery Plan

We have reviewed the subject document in response to your request (memo of February 19, 1982). We generally support this and other endangered species recovery efforts. Response from our Roswell District indicates little likelihood of public land habitats meeting the criteria described in the Recovery Plan. Within the Las Cruces District, there are larger tracts which may be suitable for future reintroductions. However, considerable inholdings of state and private lands, along with concerns involving livestock grazing on both public and private lands, would require serious consideration of the socioeconomic constraints recognized in the Recovery Plan.

Additional concerns identified include: close evaluation of effects on Desert Bighorn Sheep recovery efforts, responsibilities for NEPA compliance, more emphasis on habitat requirements of wolves, including prey availability, costs of required modification of habitats and effects of ADC operations on wolves and vice versa.

Thank you for the opportunity to comment on this Recovery Plan.

Larry F. Woodard

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FWS REG 2
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APR 27 '82
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United States Department of Agriculture
Forest Service
R-3
517 Gold Avenue SW
Albuquerque, NM 87102

team 5/3/82

Coordinator
Mgmt.
Spp. ?
COURT
Admin.
ACTION
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Reply to: 2670

Date APR 27 1982

Mr. Michael Spear
Regional Director
U.S. Fish and Wildlife Service
P.O. Box 1306
Albuquerque, NM 87103

RD
ACTION
FILE SE

Dear Mr. Spear:

We have reviewed the Agency Review Draft of the Mexican Wolf Recovery Plan.

The team should be commended for the straightforward approach they have displayed in the plan.

We look forward to progress toward down-listing the wolf and our involvement in evaluating possible reestablishment sites.

Sincerely,

James C. Overbay

JAMES C. OVERBAY
Deputy Regional Forester

APR 29 1982

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APR 29 '82

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FS-6200-11(8-80)

SE

To team 4/15/82 SE

United States Department of the Interior

BUREAU OF RECLAMATION
LOWER COLORADO REGIONAL OFFICE
P.O. BOX 427
BOULDER CITY, NEVADA 89005

IN REPLY REFER TO: LC-155-A
120.1

APR . 19

Memorandum

To: Regional Director, Fish and Wildlife Service, P. O. Box 1306, Albuquerque, NM 87103

From: Regional Director

Subject: Agency Review Draft of the Mexican Wolf Recovery Plan (your memorandum dated February 26, 1982)

We have reviewed the subject document and find no impact on Bureau of Reclamation activities. The document appears adequate for the purpose intended and we noted no deficiencies or errors significant enough to comment on.

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APR 5 1982

107

To team 4/15/82

United States Department of the Interior

NATIONAL PARK SERVICE
WESTERN REGION
450 GOLDEN GATE AVENUE, BOX 36063
SAN FRANCISCO, CALIFORNIA 94102

IN REPLY REFER TO:
N16 (WR-RNR)

March 31, 1982

Memorandum

To: Regional Director, Region 2(S.E.), U.S. Fish and Wildlife Service, Albuquerque, New Mexico 87103

From: ACTING Regional Director, Western Region

Subject: Agency review draft of the Mexican Wolf Recovery Plan

We appreciate receiving a copy of subject draft and wish to compliment all individuals responsible for its development. While we have no specific recommendations regarding modification of the plan, we will be pleased to cooperate in its implementation. Large tracts of land called for in the section on Release Areas--Habitat Considerations administered by the National Park Service are limited. However, it is conceivable they could possibly play a role in this eventual portion of the step-down plan.

W. Lowell White

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GOVERNOR
BRUCE KING

DIRECTOR AND SECRETARY
TO THE COMMISSION
HAROLD F. OLSON

Coordinator
Admin.
Nov. 7
Asst
Admin.
ACTION
FILE

State of New Mexico

DEPARTMENT OF GAME AND FISH

STATE CAPITOL
SANTA FE
87503

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To team 4/15/82

April 8, 1982

Mr. Michael J. Spear
Regional Director (SE)
U. S. Fish and Wildlife Service
P.O. Box 1306
Albuquerque, New Mexico 87103

Dear Mr. Spear:

The January 1982 agency draft of the Mexican Wolf Recovery Plan has been reviewed by personnel within the Department. I think that the members of Mexican Wolf Recovery Team, especially Norma Ames, should be commended for their efforts in preparing this recovery plan. In my opinion, it is a carefully written document that presents a logical approach that will hopefully result in the recovery of the Mexican Wolf.

Thank you for the opportunity to review the agency draft of the Mexican Wolf Recovery Plan.

Sincerely,

Harold F. Olson
Director

ls

ARIZONA GAME & FISH DEPARTMENT

2222 West Greenway Road Phoenix, Arizona 85023 942-3000

March 22, 1982

Regional Director (SE)
U. S. Fish & Wildlife Service
P. O. Box 1306
Albuquerque, NM 87103

Dear Sir:

The Arizona Game and Fish Department has reviewed the Mexican Wolf Recovery Plan and feels some comments are in order.

The recovery plan adequately and honestly addresses the re-introduction potential of the species and presents a realistic picture of the current status of wild populations. The recovery team made the best choice possible in the offering of various alternatives to be used depending on commitment and funding level.

The captive propagation program as a method of preserving the species is within the purview of federal rearing stations, zoos and live wildlife natural history museums. The Arizona Game and Fish Department will have little reason for direct participation in such a program until releases into the wild are anticipated. In that event, the Department should be involved in all phases of any wild releases in Arizona from planning to actual accomplishment, no matter how remote implementation may seem.

Sincerely,

Bud Bristow, Director

David A. Roe, Jr.,
Endangered Species Coordinator

DAR:rb

To team 5/3/82

TEXAS
PARKS AND WILDLIFE DEPARTMENT

CHARLES D. TRAVIS
EXECUTIVE DIRECTOR

4200 Smith School Road
Austin, Texas 78744

End. Sp. R-2	
Coordinator	
Mgmt.	
Sec. 7	
✓ Curtis	
Admin.	
ACTION	
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April 15, 1982

Regional Director (SE)
U. S. Fish and Wildlife Service
P. O. Box 1306
Albuquerque, New Mexico 87103

Dear Sir:

The following comments are provided in response to your letter of February 26, 1982, seeking review of the draft Mexican Wolf Recovery Plan. Your indicated reluctance to designate the future roles of specific agencies was acknowledged during the review process.

Regarding format and presentation, the diagrammatic presentation of the step-down plan aids understanding and is a valuable segment of the plan. However, the even-number pages from 42 through 56, within the diagram, were blank and unnumbered, and it is difficult to know whether something was inadvertently omitted. Assuming nothing was left out, this potential confusion should be eliminated. Typographical errors were minimal and can be corrected in the final proofing.

In general, the plan provides a satisfactory historical background, and the step-down plan appears to be sufficiently detailed in biological considerations and organizational framework. The extensive attention to maintenance of genetic purity is critical and seems to receive well-rounded discussion in the plan.

A deficiency which should be attended to is the lack of a specified communication framework to be utilized in conjunction with the plan. In the current form, numerous agencies, cooperating facilities, and contracted researchers will be involved and some tasks may require short response-times from the entire array of cooperators. At least a rudimentary communication net should be provided for, especially in light of the international scope of the plan.

Thank you for the opportunity to make comments.

Sincerely,

Charles D. Travis
Executive Director

CDT:BCT:aeh

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To team 3/30/82 IN REPLY REFER TO:
Agriculture-315

United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
ALBUQUERQUE AREA OFFICE
P.O. BOX 8327
ALBUQUERQUE, NEW MEXICO 87108

MAR 19 1982

Memorandum

To: Regional Director, Region 2 (SE), DOI, Fish and Wildlife Service

From: Area Director

Subject: Agency Review Draft of the Mexican Wolf Recovery Plan

Our wildlife staff has reviewed the subject draft and offers the following comments.

The Mexican Wolf is by nature a wild animal and a natural predator in the ecosystem of its natural habitat and ancestoral range. Its present status as an endangered specie with a considerably reduced territory is primarily due to persecution by man. This persecution was due to the animals economic competition with man for the harvest of domestic livestock and man's fear and hatred of the wolf.

If the wolf is increased and re-established in the wild and its range and numbers continued to expand, we see nothing to prevent this from happening all over again. We see no value to propagating a wild specie in captivity if the goal is not to eventually release and return them to the wild for a purpose. The wolf's natural role is the culling of wild game herds.

Researchers and managers of wolves seem to agree that a wolf release stands little chance of re-establishing wolves in the wild unless it is of wild caught wolves. It has been estimated that there may be only as few as 50 pure Mexican wolves remaining in the wild in Mexico. Therefore, it wouldn't seem prudent to capture these for a captive breeding and reproduction program. This would plainly be an example of man's continued tampering with nature and further persecution of the remainder of this specie which would result in aggravating the endangerment.

Based on the above, our recommended approach to recovery of the Mexican Wolf would be that of purely preserving and protecting the

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remaining wild stock from further persecution by man. If the wolves increase, the amount of increase which can be tolerated by man in the areas of increase should also be protected and possibly some relocated to presently designated, so called wilderness areas to re-stock these. If the present wild stock do not increase or survive with protection by those given dominion, then these wolves were destined for extinction and have the right to become extinct.

Those who do not agree may attempt to increase by breeding and reproducing presently captive stock.

This approach also seems least burdensome on the American taxpayers.

Larry W Welch

Acting Area Director

IN REPLY REFER TO

United States Department of the Interior

6840 (932)

BUREAU OF LAND MANAGEMENT
ARIZONA STATE OFFICE
2400 VALLEY BANK CENTER
PHOENIX, ARIZONA 85073

April 20, 1982

Memorandum

To: Regional Director, FWS, Region II, Albuquerque

From: Chief, Division of Resources, Arizona

Subject: Review Comments: Mexican Wolf Recovery Plan

Enclosed are the comments received from the BLM, Safford District Office which is responsible for public land management in southeastern Arizona.

Thank you for the opportunity to review this plan.

Enclosure

FWS REG 2
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APR 22 '82
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UNITED STATES GOVERNMENT

memorandum

6840 APR 8 1982
DATE:

REPLY TO ATTN OF: District Manager, Safford

SUBJECT: Mexican Wolf Recovery Plan Review

TO: State Director, Arizona (932)

Although the Mexican Wolf Recovery Plan satisfies the legal requirements of the Endangered Species Act of 1973, as amended, the potential for implementing the plan appears to be non-existent. The plan as written would have very little, if any, impact upon public lands. The proposed release site (minimum of 4,000 square miles and elevations above 4500 feet) criteria effectively eliminate the possibility of such a release on Bureau administered public lands. Additionally, as noted in the plan on page 19 "areas to be considered for initial releases of wolves should be, first, those with little or no existing use for livestock grazing..." and "wolf releases should be considered only for large tracts of public lands." No public lands in Arizona would meet the first criterion.

The following comments pertain specifically to individual steps of the step-down plan:

1. Steps 323-4 and 344-122. I know of no regulatory mechanism by which we can reduce grazing fees for an individual livestock operator.

2. Steps 324-1, 324-11, and 324-12. The increase of wild prey species, wild prey species forage, and limitation of prey species harvest would not only be very difficult to accomplish, but would not be well received by the general public or the specific ranchers involved.

3. Step 344-124. Minimizing livestock predation by the use of taste aversion or guard dogs are not tested and proven techniques. Taste aversion studies have generally been a failure and tests on guard dogs have only begun. There would be some potential for hybridization between the wolves and the guard dogs.

Lesta K. Rawhouse