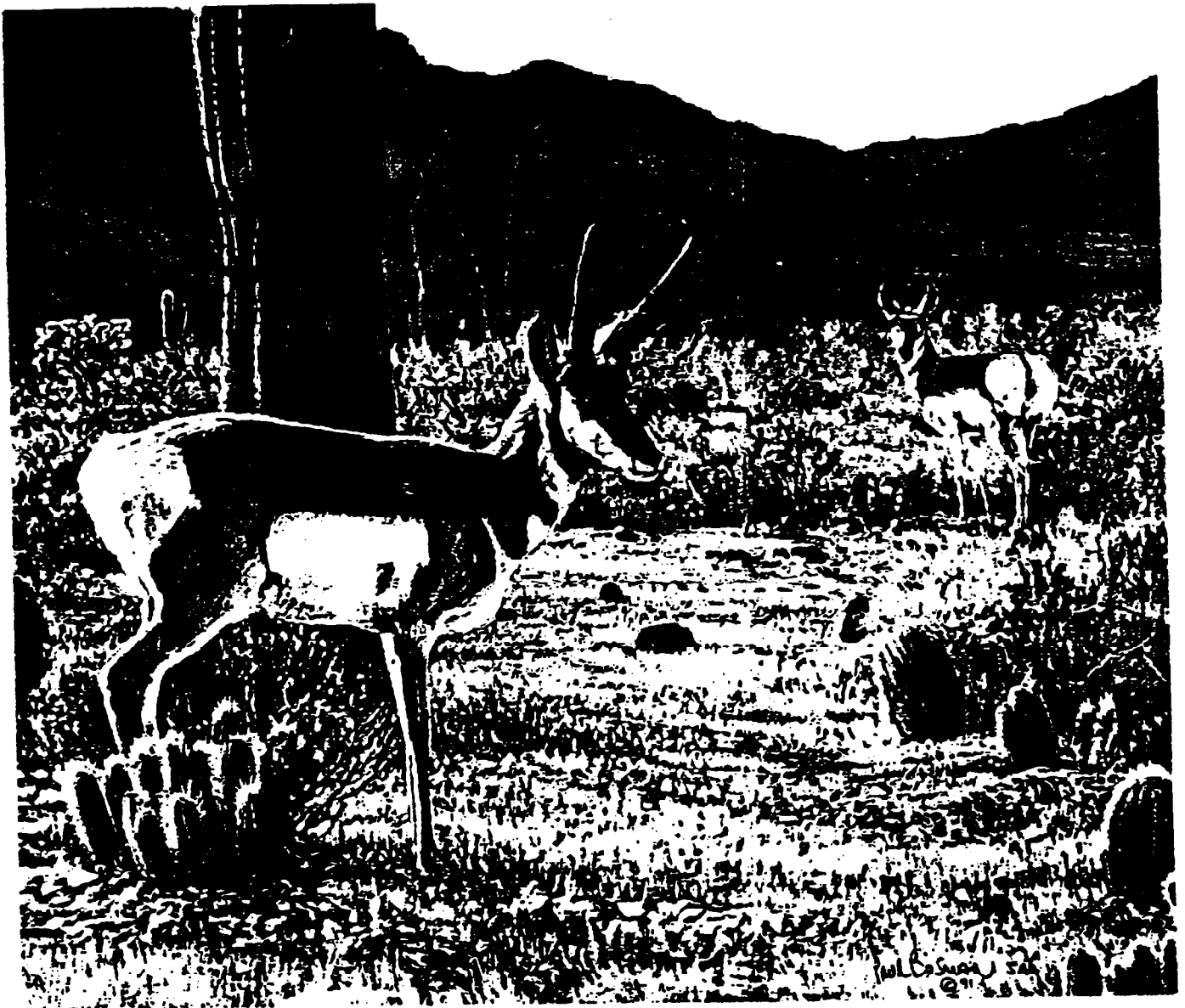


SONORAN PRONGHORN  
RECOVERY PLAN REVISION

1994



TECHNICAL/AGENCY DRAFT

SONORAN PRONGHORN RECOVERY PLAN

REVISION

(Antilocapra americana sonoriensis)

(Original approved: 1982)

Prepared By

Laura A. Thompson-Olais  
Cabeza Prieta National Wildlife Refuge  
1611 N. Second Avenue  
**Ajo**, Arizona 85321

For

Region 2  
U.S. Fish and Wildlife Service  
Albuquerque, New Mexico

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The Core Working Group was formed in May 1990 to advise the Refuge Manager of Cabeza Prieta National Wildlife Refuge regarding recovery efforts for the endangered Sonoran pronghorn. The Regional Director of Region II, U.S. Fish & Wildlife Service, assigned CPNWR as the lead office regarding recovery efforts in 1988 after the Recovery Team had accomplished their goal of writing the Recovery Plan of 1982 and disbanded. The Core Working Group consists of one representative from each agency that has a mandate for protection of the subspecies and/or manages land where Sonoran pronghorn inhabit or have inhabited in the past. These members and others have participated in reviewing this revision:

**Jim Barnett, Organ Pipe Cactus National Monument, Ajo, AZ**

**Dave Belitsky, Arizona Game & Fish Department, Phoenix, AZ**

**Tim Goodman, Bureau of Land Management, Phoenix, AZ**

**Johnson Jose, Tohono O'odham Nation, Sells, AZ**

**Carlos Castillo Sánchez, Centro Ecológico de Sonora, Hermosillo, Sonora, Mexico**

**Laura Thompson-Olais, CPNWR, Ajo, AZ**

#### ABBREVIATIONS

<b>AGFD</b>	<b>Arizona Game and Fish Department</b>
<b>BLM</b>	<b>Bureau of Land Management</b>
<b>BMGAFR</b>	<b>Barry M. Goldwater Air Force Range</b>
<b>CES</b>	<b>Centro Ecológico de Sonora</b>
<b>CITES</b>	<b>Convention on International Trade and Endangered Species of Wild Fauna and Flora</b>
<b>CPNWR</b>	<b>Cabeza Prieta National Wildlife Refuge</b>
<b>CWG</b>	<b>Core Working Group</b>
<b>IWBC</b>	<b>International Water and Boundary Commission</b>
<b>MCAS</b>	<b>Marine Corps Air Station, Yuma</b>
<b>OPCNM</b>	<b>Organ Pipe Cactus National Monument</b>
<b>RD</b>	<b>Regional Director</b>
<b>TON</b>	<b>Tohono O'odham Nation (Reservation)</b>
<b>U.S.</b>	<b>United States</b>
<b>USAF</b>	<b>U.S. Air Force</b>
<b>USFWS</b>	<b>U.S. Fish and Wildlife Service</b>

## **DISCLAIMER PAGE**

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

Some of the techniques outlined for recovery efforts in this revision are completely new regarding this subspecies. Therefore, the cost and time estimates are approximations.

Literature citations should read as follows:

**U.S. Fish and Wildlife Service. 1994. Sonoran Pronghorn Revised Recovery Plan. U.S. Fish & Wildlife Service, Albuquerque, New Mexico. 40 pp.**

Additional copies may be purchased from;

**Fish and Wildlife Reference Service:**

**5430 Grosvenor Lane, Suite 110  
Bethesda, Maryland 20814  
301-492-6403  
or 1-800-582-3421**

The fee for the Plan varies depending on the number of pages of the Plan.

## EXECUTIVE SUMMARY

**Current Species Status:** Sonoran pronghorn are currently listed as endangered and are on Appendix 1 of The Convention on International Trade and Endangered Species of Wild Fauna and Flora. It is estimated that there are fewer than 300 individuals in the U.S. and fewer than 500 individuals existing in the State of Sonora, Mexico.

**Habitat Requirements and Limiting Factors:** In the U.S., Sonoran pronghorn habitat is located in the Sonoran desert in broad alluvial valleys separated by block-faulted mountains. Creosote-bursage flats, bordered by washes (called arroyos) of palo verde, mesquite and ironwood, are utilized, especially with the presence of forbs. Mesquite-creosote habitat bordering a palo Verde/mixed cacti bajada is also used. Ephemeral washes are important during summer for thermal protection. In Mexico, medaños or fixed dunes with cholla are used in addition to the above type habitat. To date, there are no substantial data on the degree that permanent water is utilized by Sonoran pronghorn. Cacti appear to make up a substantial part of their diet. Limiting factors for this subspecies are not known.

**Recovery Objective:** Downlisting.

**Recovery Criteria:** Establish additional viable herd(s) to reach an estimated population of 500 animals in the U.S. or numbers determined feasible for the habitat (for a five year period) while maintaining present populations. Assist with recovery efforts in Mexico as requested. Criteria for delisting this subspecies are not known at this time.

**Actions Needed:**

1. Establish a protocol for a repeatable and comparable survey technique. Continue monitoring populations to track population trends in the U.S. and Mexico.
2. Investigate the use of satellite telemetry to determine unknown factors (see Recovery Outline) of life history and monitor the population.
3. Investigate, evaluate and prioritize present and future status of re-introduction sites within historic range relative to a potential captive breeding program and/or a transplant program.
4. Establish and monitor a new separate herd(s) to guard against catastrophes decimating the core population.
5. Examine additional specimen evidence available presently to assist in verification of taxonomic status.
6. Investigate relevant physiological characteristics as is possible.

Estimated Cost of Recovery: (000's)

Year	<u>'Need 1</u>	<u>Need 2</u>	<u>Need 3</u>	<u>Need 4</u>	<u>Need 5</u>	total
1994	40.0	50.0	50.0		50.0	190.0
1995	20.0	40.0	20.0		30.0	110.0
1996	20.0	40.0			30.0	<b>90.0</b>
1997	20.0	40.0		60.0	30.0	150.0
1998	20.0	40.0		30.0	30.0	120.0
1999	40.0	40.0		30.0	30.0	140.0
2000	20.0	40.0		30.0	30.0	120.0
2001	20.0	40.0		30.0	30.0	<u>120.0</u>
	200.0	290.0	70.0	150.0	230.0	1040.0

Total Cost of Recovery:

Date of Recovery: Since some significant aspects of the life history of Sonoran pronghorn are not known, a delisting date cannot be projected at this time. Downlisting will be considered in the year 2002 or sooner if the recovery criteria in this plan are considered viable and have been met. This plan is to be a short term plan (about 5 years) considering critical survival information is not yet known about this animal. Annual updating rather than re-writing or a major revision will be the goal to an up-to-date recovery plan.

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## I. Introduction

The Sonoran pronghorn (*Antilocapra americana sonoriensis*) is one of five subspecies of pronghorn. The subspecies presently inhabits southwestern Arizona in the U.S. and northwestern Sonora in Mexico. Since the completion of the 1982 Sonoran Pronghorn Recovery Plan, work has been conducted in the U.S. and Mexico providing additional information on population estimates. This revision covers recovery efforts in the U.S. and includes some information regarding Sonoran pronghorn research/recovery work in Mexico as well. Information pertaining to Mexico will be so stated, otherwise information refers to efforts being conducted in the the U.S.

The Sonoran pronghorn was listed as endangered on March 11, 1967; (32 FR 4001). Since the Recovery Plan was written, sufficient evidence has not been gained to indicate with confidence whether Sonoran pronghorn populations are increasing, decreasing, or stable. The literature has suggested that the population estimates have remained at about 80 to 100 animals. One hundred twenty-six pronghorn were observed during an aerial survey in March of 1992 and 114 were observed in February/March 1994 aerial survey in the U.S. and in Mexico, 220 animals were observed in March of 1993. The line transect method was used for aerial surveys (Burnham, Anderson, Laake 1980). Population estimates of 256 and 313 respectively for the areas surveyed were derived from the Distance program (Laake et al. 1992). This baseline data can be compared with future population estimates if range-wide, aerial surveys, using the same methods, are completed at regular intervals in the future. In terms of stochastic problems, species of larger vertebrates will almost certainly need population sizes of several hundred animals to remain viable (Ballou et al. 1989). Dispersion of populations is also important to guard against catastrophes.

Research has shed light on predatory factors, but crucial baseline information such as the relationship between Sonoran pronghorn and free standing permanent water is still unclear.

## A. DESCRIPTION

Pronghorn were first described as *Antilooe americanus* by George Ord in 1815. Taxonomists recognized that the North American pronghorn was unique, warranting it recognition as a distinct family of mammals. Ord proposed a new name *Antilocapra* in 1818. Pronghorns evolved on the prairies and deserts of western North America during the last 20 million years (Frick 1937). They are endemic to North America (O'Gara 1978). Today the total area of suitable habitat for pronghorns has been greatly restricted, possibly more than 75% (O'Gara and Yoakum 1992). Agricultural, urban, and mining expansion onto historic rangelands, fencing across routes of seasonal movements, removal of native vegetation by rangeland rehabilitation projects, and heavy livestock grazing are among some of the causes.

Pronghorns are proportionately long legged, small bodied artiodactyls distinguished by large white areas of hair present on the rump, sides of face, two bands on the throat, underparts, and part way up the sides of the body. They have slightly curved horns, each with a single prong projecting forward, and have a wooly undercoat overlaid with long, straight, coarse, brittle guard hairs. The color of the animal varies from yellowish to tan, except for blackish on the top of the nose (Hoffmeister 1986). Pronghorns are the swiftest terrestrial mammal in the New World. Kitchen (1974) clocked herds moving at 64 to 72 km per hour with an observed maximum speed of 86.5 km per hour. These speeds can be attained only on hard ground (Nowak and Paradiso 1983).

Sonoran pronghorns differ from the other four recognized subspecies: *A. a. americana*, *A. a. mexicana*, *A. a. oreaona*, and *A. a. peninsularis*. The subspecies, *A. a. sonoriensis*, first described by Goldman

(19451, from a type specimen taken 40 miles north of Costa Rica, a ranch on the northern side of the Rio de Sonora, southwest of Hermosillo, Sonora, Mexico by Vernon Bailey and Frederick Winthrop on December 11, 1932. It was described as being the smallest subspecies of A. americana. The coloration of A. a. sonoriensis was paler and cranial features were distinctively different.

The major cranial features noted to be different in A. a. sonoriensis are:

1. Skull narrower in mastoidal, orbital, and zygomatic width.
2. Frontal depression less pronounced.
3. Premaxillae less extended posteriorly along median line.
4. Auditory bullae more flattened, less projecting below level of basioccipital.

Paradiso and Nowak (1971) examined the skulls of three juvenile and one adult male Sonoran pronghorns which were collected near Caborca in northwestern Sonora, Mexico in February 1969. The adult doe Sonoran pronghorn examined and described by Goldman along with a specimen of a doe from <sup>FOR</sup> Buchanan (now called Crittenden), Santa Cruz County, Arizona plus the four above bucks were compared. It was thought that these six Sonoran pronghorns were more distinctive from the other four subspecies than they were from each other.

Special Report #10 by AGFD (1981) questions the subspecies designation of the Sonoran pronghorn. After examining the four buck skulls, the holotype, and the Crittenden specimen, the authors concluded that the measurements all fell within the range of values given for other subspecies by Paradiso and Nowak (1971). They concluded that subspecies designation was unwarranted and that further data was needed to confirm the designation. Hoffmeister (1986) states that the type specimen may be smaller than average for the subspecies and that the distinctiveness of A. a. sonoriensis remains to be ascertained, when and if more specimens become available.

Comparisons of the following specimens have not been discussed thus -far in the literature:

1. 1969: 4 Sonoran pronghorn skulls were seized by USFWS agents from a Tucson taxidermist and deposited in the U.S. National Museum; they had been illegally taken and imported by a Mexican hunter for trophy purposes.
2. June 24, 1970: dead buck was removed from the Wellton-Mohawk Canal south of Interstate 8.
3. July 10, 1972: adult buck was found along Ajo Mountain Drive, OPCNM east of Highway 85.
4. September 1975: adult doe was hit by an automobile and killed on Highway 2, 8 km west of Sonoyta, Mexico.
5. November 28-29, 1987: capture/collaring effort by AGFD in the Mohawk Valley; one doe appeared to have spinal injuries; animal' was euthanized.
6. July 2, 1989: male pronghorn recovered from Wellton Canal by AGFD brought to Phoenix Zoo, died July 2, 1989.
7. July 5, 1990: carcass found at Bates Well, OPCNM, skull at National Museum of Natural History.

In 1986 Final Report on Sonoran Pronghorn Status in Arizona (Wright and deVos), three mortalities of collared pronghorns were reported, two of unknown causes and one from predation, and were submitted to the National Museum of Natural History for taxonomic classification. A dead pregnant doe is presently located in the office of Centro Ecologico de Sonora, Hermosillo, Mexico. This totals 14

specimens which have not been examined regarding taxonomic verification.

Work regarding blood analysis such as DNA and electrophoresis is being pursued by AGFD and CPNWR to aid in taxonomic verification. Blood samples taken from the population in Arizona and Mexico have been examined in the USFWS Forensics Laboratory in Ashland, Oregon. Samples were further analyzed at Cornell University. Correspondence from Cornell Director, Bernie May in 1988 to AGFD Joan Scott indicated "no differences were found between the sonoran and mexican serum proteins which we analyzed last week". Sonoran pronghorns are currently recognized as a subspecies (Antilocapra americana sonoriensis), but further research is needed to clarify this designation.

## B. DISTRIBUTION

There is little information about the historical distribution of the Sonoran pronghorn. It was not until 1945 that the subspecies was described, prior to that date many of the collections had been listed as different subspecies (AGFD 1981). It was thought that historically they ranged from Hermosillo to Kino Bay to the south, to Highway 15 to the east, Altar Valley and in the Papago Indian Reservation (now Tohono O'odham Nation) to the north, and Imperial Valley, California to the west (Fig.1 ). On the basis of sightings and confiscated specimens, Monson (1968) states that the Sonoran pronghorn persisted in some localities along the east side of the Pinacate Lava Flow in Mexico southward to about 300 km south of Puerto Libertad in Mexico.

Areas that Sonoran pronghorns used in the past are considered historic range. Historic habitat may not necessarily be part of historic range but could be equally considered (Remington, pers. commun.). In 1980, Terry Plummer, BLM Area Manager in Riverside, California expressed interest in a re-introduction in California based on historic distribution. Historic habitat outside of historic range should be investigated if decided it might be significant to recovery efforts. But even though habitats may seem suitable, there may be physiological or biological reasons why these areas were not or are not presently used by Sonoran pronghorn. If there is historic habitat, evidence of use, past or present, by Sonoran pronghorn must be determined before considering the area for future use (J. Boggs, pers. commun.). Suitable habitat may be isolated from the historic range.

Nelson (1925) stated that in 1923, Papago Indians reported that a few antelope were still ranging in the Santa Rosa Valley, in Pima County, Arizona but no definite number was given. He reported that a few herds in northwestern Sonora, Mexico move back and forth across the Arizona border. On January 4, 1925, Ben Tinker, representing the Permanent Wild Life Protection Fund along the Sonora-Arizona border reported on a count of 595 pronghorn he conducted in Sonora in November 1924. The herds ranged from the southern end of the Sierra Rosario, south and east to the Sierra Blanca and the Rio Sonoyta, to the eastern side of the Sierra de San Francisco.

Monson (1968) discusses errors which occur in the literature and in the "The Mammals of North America" (Hall and Kelson 1959). In citations of marginal records of A. a. peninsularis, its authors quote a record (Nelson 1925) for "S beyond Magdalena Bay" for which Monson found no basis. For A. a. sonoriensis, a record (Burt 1938) for Hermosillo is quoted for which he also found no record.

Records show that Sonoran pronghorns have been seen frequently in the following areas in CPNWR: Pinta Sands, Growler Valley between the Granite Mountains and the Growler Mountains, Mohawk Valley between the Sierra Pinta and the Bryan Mountains and San Cristobal Valley between the Granite and Mohawk Mountains (Carr 1972). Sightings reported from Wright and deVos (1986) state that observations in the Growler Valley were frequent and that the Mohawk Valley, San Cristobal Valley

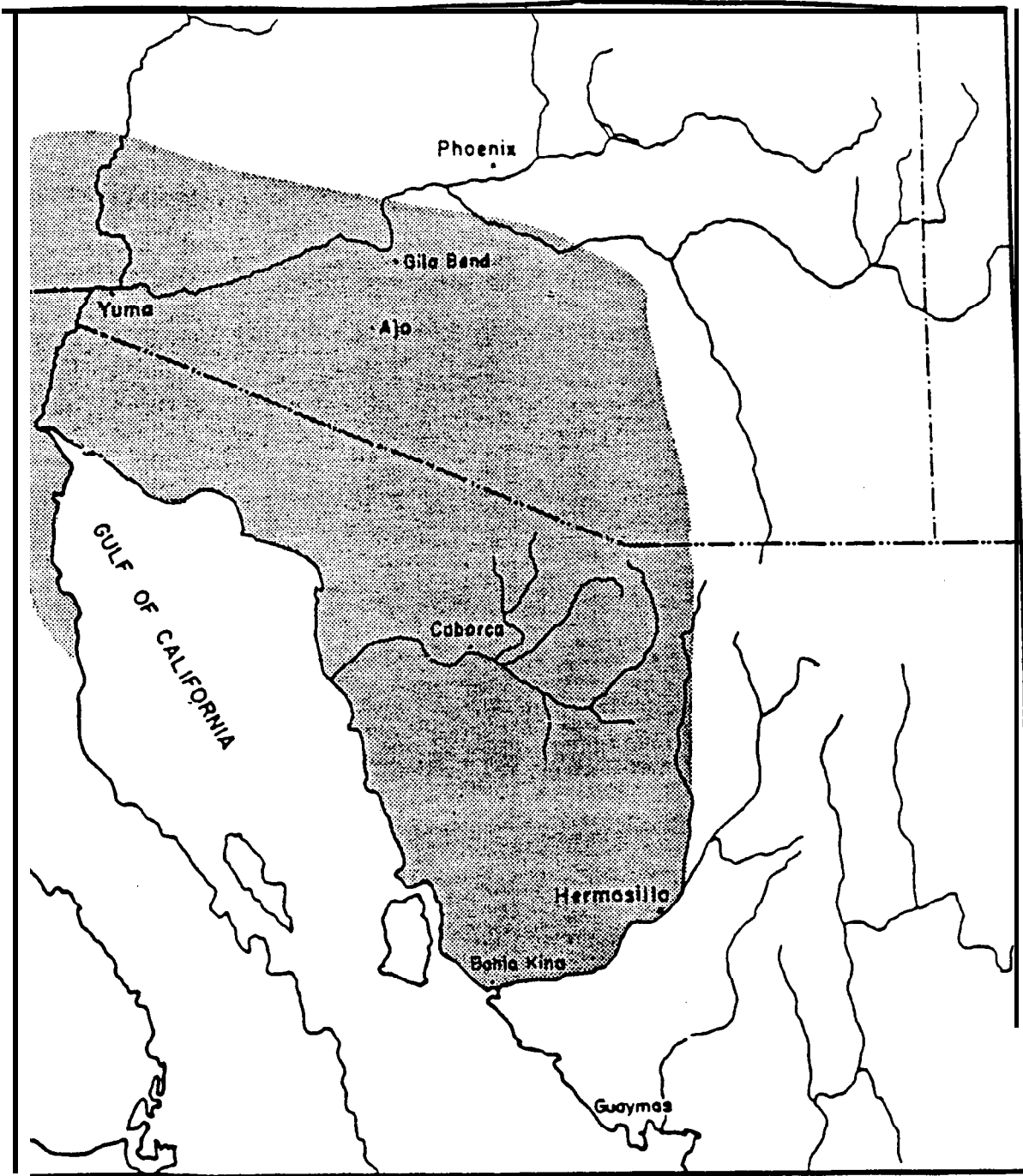


Figure 1. Historic distribution of Sonoran pronghorn in Arizona and Sonora, Mexico.

and Luke Air Force Base all support herds of 10-20 animals during most of the year. Also mentioned was a regularly observed herd of 7 to 10 pronghorns in the Cameron tanks area. Thousands of Sonoran pronghorn were reported to exist in the area in the 1890's. Antelope were found in every open valley along the boundary from Nogales to Yuma but by 1907 pronghorn were described by E.A. Mearns as a rare animal in the region (CPNWR Management Plan 1980). In Mexico, Sonoran pronghorn range near the Pinacate Lava flow, in the open valley between the lava flow and Caborca and south to possibly near Kino Bay.

In 1988, 22 A. americana were transplanted from Colorado by the Colorado Department of Wildlife to a 1,000 acre enclosure 25 km from Hermosillo, Sonora, Mexico (memo Fowler-Prospt to USFWS Regional Director). There has not been any documentation of this transplant effort affecting Sonoran pronghorn populations.

There have been infrequent repons throughout the years of pronghorn movements between Mexico and the U.S., but no long term monitoring of such movement has taken place. Since 1989, AGFD has collared 16 pronghorns with radio telemetry collars in northwestern Sonora, Mexico. This project could provide movement data near the border between the two countries. There is one report of a radio-collared pronghorn moving between Mexico and the U.S. The radio telemetry collars in the U.S. ceased operating in 1991.

Highway 2 in Mexico is directly south of the refuge and runs parallel to the south boundary of the refuge in the vicinity of refuge pronghorn habitat at Pinta Sands. This highway receives a considerable amount of fast moving vehicular traffic. Whether to modify the fence along the south boundary of the refuge to allow for pronghorn passage has not yet been answered. Modifying the fence could aid genetic diversity if sufficient pronghorn movement did occur, but might also lead to increased pronghorn fatalities from motorized traffic on Highway 2. Mexico has been asked to participate in this decision since any fence modifications could affect pronghorn populations in both countries. The refuge seven strand livestock fence is a partial barrier; there have been refuge personnel and Border Patrol reports of tracks leading under the fence in washes where it appears pronghorn have passed under.

The fence on CPNWR's southern boundary, which was built by the International Water and Boundary Commission (IWBC), is in most places a sturdy, seven-strand cattle/goat fence. In 1993, refuge staff participated in helicopter flights to check the boundary fence. The fence had been down in two locations on the west side of Pinta Sands, but has since been repaired. As of June 1993, the fence is down for about a 100' in one location south of the Tule Mountains where there is a flat narrow valley leading through to Mexico.

Increased use of highways could be a deterrent to expanding pronghorn populations. Presently, there is no information about plans to develop any new major highways in Sonoran pronghorn habitat although expanding Highway 2 in northwest Sonora, Mexico is underway (Castillo, pers. commun.). Highway 85 receives heavy traffic each year as tourists, students, and local residents travel south to Puerto Peñasco, Sonoyta and other areas in Mexico. Long-time Ajo residents reported seeing more Sonoran pronghorn near Ajo and south in the Valley of the Ajo in past years. Observations of pronghorns were supposedly not uncommon along Highway 85. The last verified observation of a pronghorn near Highway 85 was a carcass found on Ajo Mountain Drive in OPCNM in 1972. There is an unconfirmed report of four Sonoran pronghorn crossing Highway 85 in August 1993 about 1.5 km north of OPCNM visitor center. A juvenile crossed the highway (2 lanes) to the east, then heard an oncoming vehicle and ran back across the road to join the other 3 pronghorns (Ramon, TON, pers. commun.).

Today, Sonoran pronghorns are found in Arizona on CPNWR, OPCNM, the BMGAFR extending from Highway 85 west to the Lechuguilla Desert and south to the Mexican border. In 1970, Carr observed

8 pronghorns near Pisinimo on TON. Unconfirmed sightings recently (1987) have been reported (Carver, pers. commun.) on TON. Sightings have also been reported north of Highway 8. BLM employee Tim Hughes reported a herd of about 10 animals about 3.7 km east of Aztec on the north side of Highway 8 (this was stated as a possible sighting). He saw them several weekends in a row while driving to Yuma. Two adults were sighted approximately eight km southeast of Mohawk Pass on Highway 8 (R13W,T8S,Sec 31 ) in February 1990 (Goodman, pers. commun.).

The minimum number of pronghorns on the west side of the range is a herd of about 12 animals west of Mohawk Mountains in the Lechuguilla Desen. This group was not seen in the recent survey as this location was inaccessible due to military exercises at that time. Recent sightings in May 1993 (Payne, pers. commun.) by Border Patrol agents reported 11 pronghorns near the northern tip of the Cabeza Prieta mountains.

In Mexico, Sonoran pronghorns have been sighted just to the east of Sonoyta, directly south of Lukeville on the border; northeast, east, and southeast of Puerto Peñasco and on all sides of the Sierra Pinacate. A number of Sonoran pronghorn were sighted east of Puerto Peñasco during the March 1993 aerial survey. Surveys to be conducted in Mexico include regions with suitable habitat from Kino Bay, north through the historic range, to the southern extent of the recent aerial surveys. This would provide coverage of all areas with historic records for this subspecies. (deVos, pers. commun.)

Results from three aerial surveys in April and December 1992 (in the U.S.) and March 1993 (in Sonora, Mexico) are shown (Fig. 2 and Fig 3.). Two locations in the U.S. which were not included in the 1992 aerial surveys were north of Black Gap on the BMGAFR immediately west of Highway 85 and the entire Lechuguilla Desen to the west and northwest side of the CPNWR. These surveys, in addition to previous AGFD telemetry work show recent distribution areas.

### C. HABITAT

Brown (1982) discussed seven subdivisions of the Sonoran desert, two which encompass the habitat of Sonoran pronghorn. These are the Lower Colorado River Valley (LCRV) and the Arizona Upland (AU). Within the LCRV creosote (Larrea tridentata) and white bursage (Ambrosia dumosa) constitute a major portion of this subdivision. Drainages in the LCRV assume two forms: in the drier areas channels provide infrequent flows connected to networks of shallow rills which do not provide through flow. Water in these anastomosing systems usually ends up in a playa or a plain; the other drainage pattern occurs in areas of more relief or rainfall and carries runoff to some regional drainage. Species along major water courses include ironwood (Olneya tesota), blue palo verde (Cercidium floridum) and mesquite (Prosopis spp.). Species in the AU include foothill palo verde (Cercidium microphyllum), catclaw acacia (Acacia aragarii), along with chain fruit cholla (Ooumtia fulvida) and teddy bear cholla (Q. bialovii).

The habitat of the Sonoran pronghorn in the U.S. consists of broad alluvial valleys separated by block-faulted mountains. Elevations in these valleys vary from 122 m near the Mohawk Valley in the west to 488 m in the Valley of the Ajo to the east. Drainages run north and south. The mountains are of two major types: a sierra type, composed of metamorphic and granitic rock; and a mesa type, typically of basaltic composition. Only the Ajo Mountains exceed 1219 m in elevation. The mountain ranges run northwest to southeast with valleys draining to the north towards the Gila River and to the south towards Rio Sonoyta in Mexico. These valleys are fairly level and are dominated by creosote and white bursage. The creosote and triangle-leaf bursage (Ambrosia deltoidea) association might prove important if found in areas of particular pronghorn activity such as bachelor herd concentrations. The west boundary of OPCNM and the southeast corner of CPNWR consist of this vegetation and large groups of 11 or more pronghorns have been sighted here on several occasions. Sonoran pronghorns are found in the creosote-bursage association the Year round and in the palo Verde-mixed cacti association from

Figure 2. US SONORAN PRONGHORN AERIAL SURVEY - DECEMBER 1992

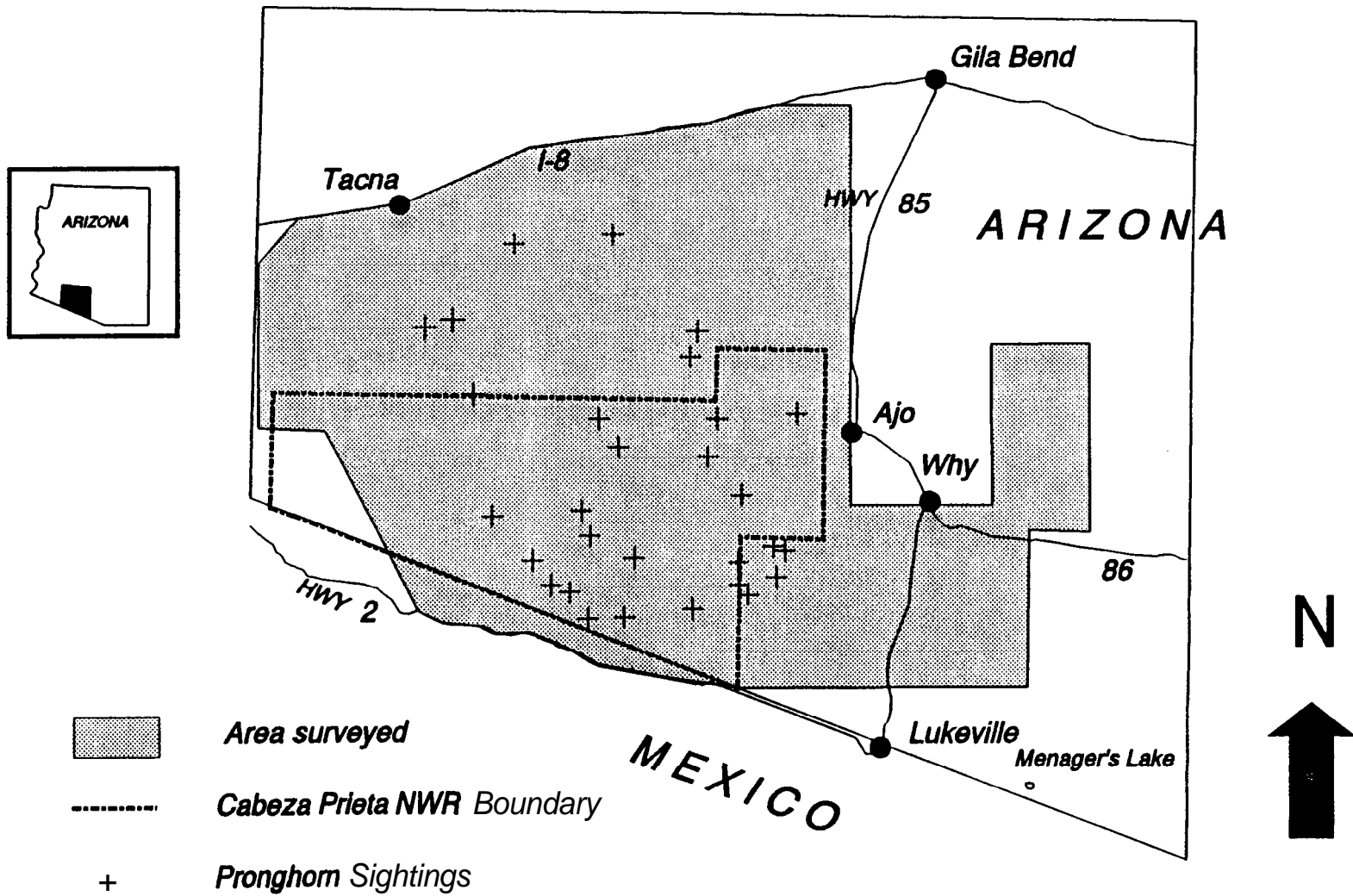
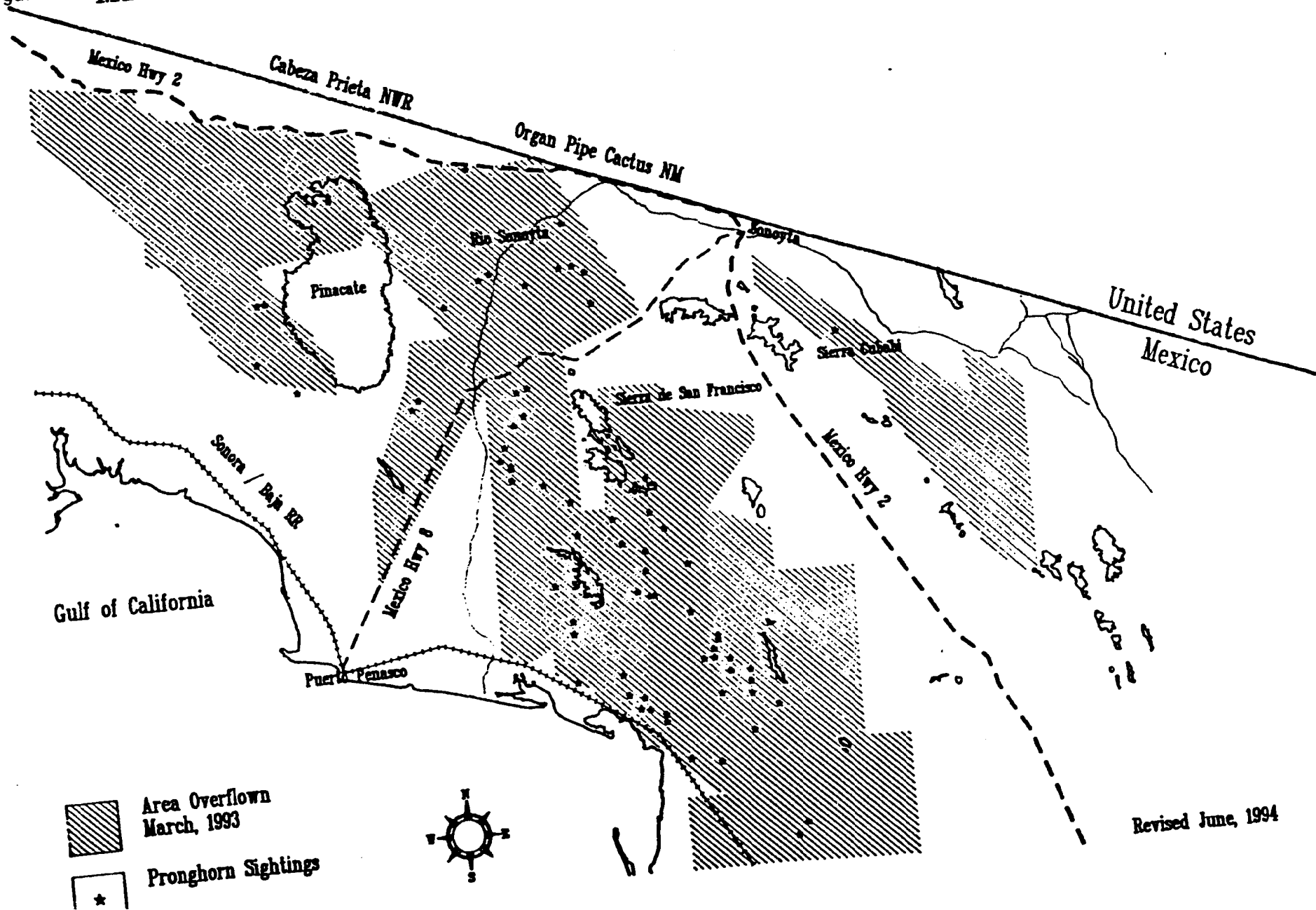


Figure 3. MEXICAN SONORAN PRONGHORN AERIAL SURVEY - MARCH 1993





late winter to early fall.

Washes or arroyos flow briefly after rains during the monsoon season from July through September; the network created by these washes is an integral part of the habitat during the hot summer seasons for Sonoran pronghorn for thermal cover. Drainages and bajadas are used during spring and summer. Bajadas are used in spring as fawning areas. Palo verde, ironwood, and mesquite are commonly used by pronghorns for cover. The areas which pronghorns occupy consist of about 11% ground cover (Hughes and Smith 1990).

The Sonoran desert climate is characterized by extreme aridity and heat. Summer temperatures from May to September range from 38-44° C with the remainder of the year ranging from about 19-25° C. Annual average precipitation is about 127 mm in a bimodal pattern occurring during December to February and during the monsoons.

Pronghorns were observed in playas in April and May of 1988 and 1989 when forbs were abundant, later vacating these areas when desiccation of forbs occurred (Hughes and Smith 1990). In good rain years, some playas produce abundant forbs as a result of water collection and the inability of the water to percolate through the hardpan.

Some of the sandy areas within Sonoran pronghorn habitat such as Pinta Sands, the Mohawk Dunes west of the Mohawk Mountains, and the west side of the Aguila Mountains provide a greater variety of vegetation on a seasonal basis. The openness of these areas appears to be attractive for pronghorns as the annuals, grasses, and shrubs provide good forage species particularly in the spring. These areas have long been considered significant Sonoran pronghorn habitat in the U.S.; although data are lacking on which characteristics of such significant habitat are preferred over more lightly used areas. Large numbers of pronghorns were observed by AGFD in the late 1960's in the Pinta Sands area. These dunes are important in the spring when annuals are present. Due to the more arid nature of the western portion of pronghorn range, these annuals dry and cure with decreased palatability as summer approaches. Also, the dunes lack sufficient tall trees for thermal protection which potentially limits the temporal suitability of these areas. In December of 1984, 40% of the pronghorns observed during a telemetry flight were in the Growler Valley, from the Aguila Mountains to the International border. In the AGFD 1985 report, it was reported that pronghorns used flat valleys and isolated hills to a greater degree than other topographic features.

Cattle were removed from CPNWR in 1983, OPCNM by 1978 and from LAFB by 1986 (NRMP LAFB 1986). Livestock have contributed to the changing vegetation composition of the desert region, but may not have been the primary agent of change. It seems likely that cattle have influenced changes in the desert grassland more than in other zones. Their influence may have been considerable (Hastings and Turner 1980). Changes over time in Sonoran pronghorn habitat have not been monitored sufficiently to draw definitive conclusions regarding the impacts of habitat changes on population numbers. Literature references, particularly AGFD Special Report 10, were from an era of high livestock numbers in the eastern section of pronghorn range. Were pronghorn displaced from preferred habitat by livestock? This seems possible given the given the fact that the distribution of sightings seems to have shifted to the east with cattle removal (deVos, pers. commun.).

The degree to which Sonoran pronghorns utilize permanent, free standing water is probably the least understood aspect of this animal. Early management efforts such as the construction of the Jose Juan and Redtail charcos in the Growler Valley in pronghorn habitat centered on providing permanent water based on little documentation of use by Sonoran pronghorn. CPNWR has maintained up to eight artificial water sources which are accessible to pronghorn: Jose Juan and Redtail charcos, Antelope and Mohawk Valley parabolic collectors, Jack's well, Little Tule, Charlie Bell and Adobe guzzlers (Updated Planning Needs Assessment, 1986). Charcos are man-made water reservoirs containing up

to many thousands of gallons of water usually situated in a major drainage in a valley. Livestock may be injured by drinking water that contains excessive dissolved solids, and an assumption might be made this also applies to pronghorns (O'Gara and Yoakum 1992).

There is the question of whether water developments provide positive or negative results regarding Sonoran pronghorn. Water developments such as a charco, with dense vegetation surrounding it, may act as a predator sink. The unnatural amount of cover present might be providing a lush habitat, resulting in a higher number of coyotes, bobcats, or golden eagles than would naturally be present if no water source existed at that location. Evidence is needed on whether Sonoran pronghorn use free standing water and to what extent. Pronghorns have been reponed near guzzlers in the Aguila Mountains, the Jose Juan and Redtail charcos and Antelope parabolic collector on CPNWR. Pronghorn might be more interested in the resulting vegetation around artificial waters than the water itself.

The question of water as a limiting factor has not been answered. Distances from water sources have been recorded. Wright and deVos (1986) reponed distances of 5.1 km (4.6 for 6 females and 6.8 for 4 males). Hughes and Smith (1990) reponed > 6.1 km distance observed to water sources. There is only one documented photo of a Sonoran pronghorn with its head down at the Charlie Bell guzzler.

Monson (1968) stated there is no evidence that pronghorns drink water even though it may be available. This trait is shown by Arabian and African ungulates, as well as with mule deer of Lower California. Seton (1937) and O'Connor (1939) ascribe such ability to the consumption of succulent plants, ingestion of water through eating succulents, plus various physical and physiological adaptations that conserve the water obtained. Phelps (1974) commented that Sonoran pronghorns may not drink water from May to August. Habitat manipulation, particularly water development, designed to increase population density may actually have the opposite effect (AGFD 1981). If water is available, pronghorns will drink freely, but, if necessary, they can derive sufficient moisture from plants (Nowak and Paradiso 1983).

Unconfirmed reports from an Ajo resident on the north side of the Cardigan Mountains (just west of Ajo) state that pronghorns have been observed at an improved seep on his property eating algae, but not drinking water (McGrady, pers. commun.). In 1970, John Scocia, a student studying coyotes on CPNWR, camped during April and May at Jose Juan tank and reponed seeing no pronghorns or sign in the area, although his presence in the area presented a bias for collecting such data.

Beale and Smith (1970) found that water consumption varied inversely with the quantity and succulence of the plants consumed. Pronghorns did not drink water even if available when moisture content of the plants was 75 % or more. When the driest conditions prevailed, the animals drank about 3.3 liters per day, consuming different amounts between the two extremes. Reynolds (1984), in a study in southeastern Idaho, recorded no directional movement by pronghorns to water sources. He commented that vegetative moisture provided sufficient water for metabolic maintenance.

Hughes and Smith (1990) found no significant difference in average distance to water between the dry and wet seasons in either year of their two year study, which covered the period between March and August. No evidence (sightings, scat, or tracks) of pronghorns frequenting water sources was seen during this study.

In the Wright and deVos (1986) study, pronghorns were observed at water troughs in November, January, and August and tracks were documented at seasonal potholes during the monsoon season indicating a seasonality in their usage of troughs. The work done by AGFD was year-long and continued for several years. Six pronghorns were observed at Jack's guzzler in September 1987 (Van Riper pers. commun. with Larry Heathington) and also in the same year, a pronghorn was photographed at the guzzler at Charlie Bell well. In Sonora, Mexico, pronghorns are reportedly found where there are

no water sources and there is no evidence of them traveling long distances to obtain water (Castillo, pers. commun.). Long term monitoring, systematically collected, needs to be implemented to learn more about water needs.

## DIET

Hughes and Smith (1990) observed Sonoran pronghorns eating triangle-leaf bursage, chain fruit cholla, mesquite, and mistletoe (Phoradendron spp.) Pronghorns were observed eating cholla fruits 70% of the time. Evidence of foraging on the following species was reported: Erodium texanum, Monolepis nuttalliana, Plantago insularis, Daucus pusillus, and Gaillardia arizonica. Foraging on ocotillo leaves (Fouquieria splendens) has been observed and documented on video in Sonora, Mexico.

Diet analysis has been completed over the years on Sonoran pronghorns. Fecal analysis completed from 1974 to 1977 by AGFD consisted of 69% forbs, 22% shrubs, 7% cacti, and 0.4% grasses. Hughes and Smith (1990) reported that cacti were the major diet component (44%) with forbs (33%), shrubs (11%), trees (11%), and grasses (0.4%) shown as lesser components; Hugh also lists percentage of water in cactus species. Carr (1970) observed pronghorns feeding on brittle bush (Encelia farinosa), plantain (Plantago spp.), and palo verde. Monson (1968) reported pronghorns feeding on ironwood.

In 1993, AGFD began investigating vegetation species present within and around core areas used by pronghorns testing the hypothesis that areas were selected by pronghorns because of vegetative differences between core areas, home ranges, and non-use areas. Transects were utilized. Non-use areas were defined as areas not included within any home ranges known from radio telemetry data. Data collected included vegetation structure (height and density) and species composition.

## D. LIFE HISTORY

Much data has been collected over the years regarding the life history of Sonoran pronghorns. There is still much to be learned, however, regarding preferred habitat, forage, predation threats, relationship to water, disease, and parasites in order to understand limiting factors for this subspecies.

**Reproductive Behavior:** Pronghorn does become sexually mature at 16 months and bucks at one Year of age (Kitchen and O'Gara 1982). Gestation for all A. americana subspecies is about 240 days. Does have been observed with fawns from February through May. Parturition occurs from February through May and rut during July, August, and September. This appears to coincide with spring forage abundance.

**Group Size:** Hughes and Smith (1990) found an average group size of 2.5 animals during their two year study on Sonoran pronghorn. Wright and deVos (1986) found an average group size of 5.1, with the largest group observed being 21 animals; they observed seasonality in the group sizes. Groups of 6-15 were observed during the late fall and winter. Groups or herds began to splinter during the late winter and solitary pronghorns were more common during the spring. During summer and early fall, herd size was five to six animals.

**Group Composition:** Hughes and Smith (1990) reported group composition for buck, does, and fawns to be 84:100:30. The first fawn was observed on April 22, having been born sometime between April 14 and 22. Observations associated with collared pronghorns were made 57 times. Wright and deVos (1986) reported a ratio of 60:100:50; this being calculated from an aerial location of 56 collared and uncollared pronghorns on December 22, 1984. They reported buck to doe ratios being the narrowest

during winter and July (68:100 and 63:100) and widest during the fall (24-44:100). The first fawn observed was in March of the year. During a five year period on CPNWR, Carr (1973) estimated the composition to be 56:100:28 (n = 493).

**Movement and Home Ranges:** A radio-collared female moved about 17.6 km from the Growler Valley into Daniel's Arroyo between March 30 and April 2, 1989. She moved in a somewhat circular pattern of shorter distances in Daniel's Arroyo until mid-August (Hughes and Smith 1990). Wright and deVos (1986) reported from results of aerial telemetry efforts that movements of males ranged from 30 to 42 km and for some females ranged around 42 km. Home range size of males varied from 64.5 km<sup>2</sup> to 1213.6 km<sup>2</sup> and for females ranged from 40.7 km<sup>2</sup> to 1143.7 km<sup>2</sup>.

**Social Behavior:** Males associated loosely with female groups in the late summer. Males chased, herded, and moved females from their bedding areas. Adult males were observed to be more aggressive toward females and juveniles than towards each other. Adult males postured aggressively towards one another but did not make physical contact such as sparring or butting on a frequent basis. Juvenile males were aggressive towards one another and towards females. Juvenile males were observed sparring and posturing aggressively. Adult males were observed marking shrubs and void-marking the ground (Hughes and Smith 1990).

Human traffic, such as a person walking past pronghorns in an enclosed pen, running past, a motorcycle driving past, a truck driving past, a truck blowing its horn and driving past, and a person entering the pen cause an increased heart rate response in pronghorns. In a study in Ogden, Utah various types of disturbance were correlated with changes in heart rate on American pronghorns which were in 1/2 acre holding pens (Workman et al. 1992). The highest heart rate responses occurred with female pronghorns when a person entered their pen or a truck was driven past their pen while blowing the horn. The lowest response occurred when a motorcycle or truck was driven past their pen. Other investigators have shown that heart rate increases in response to auditory or visual disturbance in the absence of overt behavioral changes (Thompson et al. 1968, Cherkovich and Tatoyan 1973, Moen et al. 1978).

One herd of Sonoran pronghorn was observed 1% hours later and 18 km away from the initial observation location during an aerial reconnaissance (Wright and deVos 1986). Hughes and Smith (1990) found pronghorns ran immediately from their vehicle to about 400-500 m distant and that military low-level flights over 3 pronghorns caused them to move about 100 m from their original location.

## E. REASONS FOR LISTING

Relative to historic observations, pronghorn numbers in Arizona and Mexico were low and declining by the late 1800's and 1900's (Mearns 1907). The 1982 Recovery Plan states the most popular reason for decline to be over-hunting. But with protection from hunting for over 50 years, pronghorn would have recovered if hunting was one of the primary factors. Much of the habitat has been protected as public land withdrawals since the early 1940's. Habitat impacts referring to degradation of forage species have been reduced on much of the prime habitat due to the removal of cattle since 1983.

A review of the literature includes the following reasons for the decline of Sonoran pronghorns: illegal hunting (isolated incidents may occur as there was an unconfirmed report of a pronghorn taken on the TON in 1992; in 1984, Secretaria de Desarrollo Urbano y Ecologia (SEDUE) reported 11 pronghorns taken by hunters in Mexico, loss of habitat from livestock grazing, drying of the Gila and Sonoyta

rivers, and human encroachment. Aerial gunning of wildlife occurred as late as the 1980's (Keeler, pers. commun.).

There have been considerable changes in the Gila River in Arizona and the Sonoyta River in Mexico due to agricultural and human development in these areas. The drying of the Gila River in Arizona and other rivers in Sonora may have been a significant cause of the species becoming endangered (Carr 1972). These rivers are potentially important in the historic survival of pronghorns. Historic descriptions of these rivers suggest a greenbelt that could have contributed to pronghorn survival not from a drinking water resource standpoint, but rather by providing green forage during a time of year when this resource was limited in the rest of the range. This could have been important to reproductive females (deVos, pers. commun.). Dated records indicated substantial observations of Sonoran pronghorns in the Santa Rosa Valley in the TON east of Ajo. Habitat changes, possibly due to over-grazing and agriculture, appear to have taken place on the TON. Apparently small changes in habitat may result in a loss of small populations such as Sonoran pronghorn.

The level that predation influences pronghorn population numbers is not fully understood. Pronghorn are often restricted in their movements by agricultural areas, highways, and fences; thus some herds may remain relatively small and localized. Under such artificial circumstances, predators may keep pronghorn populations from increasing or eliminate them (Udy 1953). Control of predators to benefit a big game population often involves reduction of predators over a large area; even if desirable, this type of control is seldom economically feasible and once terminated, conditions may revert back to pre-control conditions.

Predation is more significant on marginal pronghorn rangelands or other areas where numbers of predators are high in relation to pronghorn numbers. Most fawns killed are between 1 and 3 weeks of age, while separated from their dams (O'Gara and Yoakum 1992). Trainer et al. (1983) reported that 87% of fawn mortality occurred during the first three weeks of life in their study area in Oregon. If suitable habitat is not available for a prey species, no amount of predator control will bring about flourishing populations of that prey species (Hornocker 1970). Also, controlling one species of predator may be compensated for by increased predation by other species, as happened on the National Bison Range when coyotes were reduced and predation by bobcats and golden eagles increased (Corneli et al. 1984). Coyotes and lions have been documented to take collared pronghorns in Arizona and in Mexico. Predation has been a significant factor in both populations of Sonoran pronghorns (deVos, pers. commun.).

All factors affecting pronghorn survival need to be considered separately and in concert with other factors. Such is the case with cattle grazing. Livestock grazing is administered by the BLM on active allotments around Ajo. For a number of reasons, these allotments in recent years have been stocked well below allowable numbers and forage conditions are good with a general upward trend (BLM comments to this plan). Rangelands can be altered rapidly by livestock (Wagner 1978, Kindschy et al. 1982, Wald and Alberswerth 1989, Yoakum et al. in prep.). These changes can affect both the quality and quantity of preferred forage needed to sustain thrifty pronghorn herds (Ellis 1970, Howard et al. 1990).

The following reflects the population estimates for Sonoran pronghorns over the past 69 years. Documented population estimates from literature citations are as follows:

- 1925 - Nelson estimated 595 in Sonora and 105 in Arizona.
- 1941 - Nichol estimated 60 in SW Arizona excluding OPCNM.
- 1956 - Halloran - less than 100
- 1957 - Villa - more than 1,000 in NW Sonora
- 1968 - Monson - 50 in Arizona

1972 - 1982 AGFD estimates: more than 50, less than 100 Arizona  
1981 - AGFD estimates in Mexico 200-350  
1983 - to present AGFD/USFWS estimates: 80 - 100 in Arizona  
1993 - 256 for the U.S. and 313 for Mexico are USFWS/AGFD estimates (126 observed by CWG aerial survey in Arizona and 220 in Mexico)

## F. CONSERVATION MEASURES

### Past Recovery Efforts:

Recovery efforts officially began in 1975 with the first meeting of the Sonoran Antelope Recovery Team. The Sonoran Pronghorn Recovery Plan, dated December 30, 1982 was prepared for the USFWS by the Recovery Team (John S. Phelps (Leader), Roger DiRosa, Ted Corderey and Terry Peters.) With acceptance of the Plan by Region 2 Director, Mike Spear disbanded the team.

From 1969 to 1982, AGFD investigated many parameters of Sonoran pronghorn ecology including population numbers, sex and age composition, and seasonal distribution (Phelps 1974). Beginning in 1983, AGFD began investigating life history, population movements and dynamics. Ten pronghorns were collared in 1983 and nine more in 1987. These pronghorns were monitored during the period 1983 to 1991 by AGFD and USFWS. Funding assistance was provided by BLM and USAF. Reports from these studies are cited in this plan.

Other areas of needed information have been pursued. Since 1986, AGFD has been working with CES in Sonora, Mexico on recovery efforts. In 1990, AGFD completed a study entitled 'Evaluation of Sonoran Pronghorn Movements Around Military Activity Areas and Habitat Use Patterns On Barry M. Goldwater Air Force Range, Cabeza Prieta National Wildlife Refuge and Organ Pipe Cactus National Monument'. The purpose of the study was to document movement patterns of pronghorns and evaluate whether these patterns were influenced by military activity (bombing and low level flights) sites. The conclusion drawn from this study indicated that military activity observed did not negatively impact Sonoran pronghorn. Topography and vegetation type were suggested as being the most important factors in determining movement patterns. Additional analysis was suggested in aiding the interpretation of this study.

By 1989, CPNWR removed all livestock fencing around drinkers/guzzlers on the refuge as literature review suggested pronghorns are wary of small enclosures. Approximately 19 km of fence has been removed separating CPNWR and OPCNM in order to facilitate pronghorn passage. About 1.2 km of fence remains to be removed. The refuge has also been promoting public education programs on conservation of ironwood, an important source of thermal cover and food for pronghorns.

In 1989, AGFD and the Phoenix Chapter of the Safari Club International discussed providing funding to construct a Sonoran pronghorn facility at the Phoenix Zoo for purposes of captive breeding. The Zoo also expressed interest in developing a Sonoran pronghorn exhibit. CPNWR considered an enclosure to study effects of low level military flights on pronghorns. The proposal was prompted by the USAF F15E Lantern activities at 100' above ground level over pronghorn range. After review by the involved agencies, LAFB, CPNWR, USFWS Ecological Services office, AGFD, and BLM, the enclosure proposal was discarded in January 1990.

In 1990, AGFD began investigating Wildlink telemetry collars for use on Sonoran pronghorns and decided to experiment with surrogate species before using them on Sonoran pronghorns. Keith Hughes and Norman Smith completed an investigation on Sonoran pronghorns which took place from January 1987 to May 1990 and looked at the following: habitat utilization relative to distribution of water and

to vegetational characteristics, life history observations, and reactions to human disturbance (Hughes and Smith 1990). Also in 1990, CPNWR hired the first full-time Ecologist position for the refuge and acquired a Geographic Information System to assist recovery efforts. In November 1990, the International Sonoran Antelope Foundation was established by the Camp Fire Conservation Fund based in Phoenix, Arizona. This was created to “retrieve from the edge of extinction a subspecies of the American pronghorn antelope”. In an attempt to assist with funding recovery efforts in the U.S. and Mexico, wildlife artist Paul Bosman donated a pastel picture of a Sonoran pronghorn buck near Charlie Bell Pass on CPNWR which was made available for sale to the public through the Foundation and by other means. Public education of Sonoran pronghorn status by means of media and printed maner have been discussed by the Foundation.

In May 1991, the Core Working Group was formed. Two priorities were decided: complete aerial surveys to obtain an updated population estimate and revise the 1982 Recovery Plan. To date four aerials surveys have been completed: a pilot survey in April 1992 in the U.S. and Mexico, a nine day survey in the U.S. in December 1992, an eight day survey in the U.S. in February/March 1994 and a five day survey in Mexico in March 1993 resulting in updated pronghorn population estimates for both countries.

One of two problems discussed in the 1982 plan was the economic development and consequent degradation of pronghorn habitat in Mexico. In a report by CES, “Strategies for the Recovery of Sonoran Pronghorn, Phase 2: Capture, Marking and Protection” completed in August 1992, reponed cattle grazing to be extensive throughout portions of the habitat. Hunting did not appear to be as much of a problem as in the past.

CES biologists have completed ambitious education campaigns throughout the habitat and in surrounding areas in efforts to deter illegal hunting. These biologists reponed that within the last three years, illegal hunting has decreased due to the constant presence of the CES biologists in these areas.

Useful and reliable population data can be gathered by using statistically sound sampling methods and by maximizing search intensity of search units (O’Gara and Yoakum 1992). The CWG is investigating using the line transect method as standard protocol for aerial surveys for Sonoran pronghorn. Use of a sound sampling design does not ensure an unbiased estimate of overall population sizes. Ideally, some method of estimating search efficiency should be employed on a portion of the sample units so that adjustments can be made for bias. For line transects, double sampling can be used or results should be compared to known density areas (White et al. 1989) to correct for bias.

The objective of the Sonoran pronghorn aerial surveys was to conduct a systematic repeatable survey of Sonoran pronghorns within their range to derive a population estimate based on simultaneous double count and line transect methods. Ninety percent of the area was covered in the U.S. in 1992. The 1994 aerial survey covered the entire known Sonoran pronghorn habitat in the U.S.

In 1993, The Wilderness Society, along with the Sierra Club, filed suit against selected USFWS refuges on the compatibility issue of secondary uses. CPNWR was named for permitting military low-level flights to occur over the refuge. The need for documentation relative to effects of military presence and pronghorns are being discussed as part of this process. A draft Environmental Impact Statement is being prepared regarding the impact of military activities on Sonoran pronghorn at the Yuma Training Range, which encompasses the western half of CPNWR.

#### Potential aroiects for the Future:

The evaluation of core use areas and forage species is presently being evaluated by AGFD with use

of the GIS system. In the summer of 1993, data was gathered on vegetation density and structure on BMGAFR, CPNWR, and OPCNM. Forage preference and status within Sonoran pronghorn habitat in the U.S. is a crucial area where more information is needed. GIS system technology should enable agencies to better analyze collected data and determine future research needs.

More than 200 food habit studies have been conducted during the past 50 years regarding pronghorns. However, these studies involved differing techniques and the findings often were not comparable (Sundstrom et al. 1973, Yoakum 1990). To provide consistency for comparison in future studies Yoakum (1990) lists guidelines which might be of assistance for Sonoran pronghorn food habits studies.

Historic range and habitat information is needed for evaluating and prioritizing re-introduction sites. Increasing the numbers of pronghorn in presently used habitats such as Tule Valley and Mohawk Valley on the BMGAFR could be investigated relative to carrying capacity. These areas need more monitoring to determine levels of use by pronghorns. The Colorado Division of Wildlife developed one of the first procedures for determining potential suitability of areas for translocations (Hoover et al. 1959). The International Union for Conservation of Nature and Natural Resources (1987) summarized the same criteria as a feasibility study, preparation phase, release or introduction phase, and follow-up phase. The latter often has been neglected and feasibility studies and preparation phases have been inadequate in many cases (O'Gara and Yoakum 1992).

At times, sportsmen's organizations, conservation groups, or local governments recommend translocating pronghorns into areas not capable of sustaining herds. Such endeavors resulted in the loss of animals transported to Florida and Hawaii. Analysis of these two cases disclosed that the proposed sites did not meet pronghorn habitat requirements. Ignoring basic biological requirements results in eventual death of translocated animals, high expenditure of public funds, and a negative reaction by the public (Yoakum 1978). Similar unsuccessful translocations have been made into areas of unsuitable habitat in other states and in Mexico. Likewise, mixing of significantly different populations or subspecies might precipitate the extinction of a subspecies.

Re-introducing pronghorns involves large amounts of manpower, time, and funding, therefore it is recommended that detailed feasibility studies and management plans be developed before translocation is seriously considered. Re-introduction goals should address the question of establishing a viable herd. Relocated herds that increase 20-30 % within 5 to 10 years after release are indicative of herds that are responding to suitable habitat conditions. Franklin (1980) considered 50 breeding adults the minimum for a viable population. Hoover et al. (1959) recommends translocations should contain 50-100 animals. These studies might serve as guidelines for acceptable population growth of Sonoran pronghorn.

Some factors to consider for re-introductions are: what caused the animals to become extirpated? Do factors responsible for their elimination still exist? Has the habitat or other conditions been altered so much that pronghorn habitat requirements are no longer met? Do current land uses and landowners favor re-introductions (O'Gara and Yoakum 1992)? Other guidelines are available by Hoover et al. (1959). Strategies for evaluating sites may have applicability in assessing other potential sites, to establish priorities, and provide insight regarding the feasibility of a transplant or re-introduction.

Both CPNWR and AGFD are researching satellite telemetry to investigate parameters of this subspecies such as habitat use, i.e. use of bajadas and valleys, areas frequented near water and distribution. It is important that clear objectives be decided before embarking this technology versus conventional telemetry (L.Pank, pers. commun.). Satellite telemetry would be less intrusive and would not interfere with military exercises in pronghorn habitat.



A factor which has yet to be studied regarding Sonoran pronghorns is the long term effect of military low-level flights which occur over the majority of their habitat. There are more training exercises taking place on habitat used by Sonoran pronghorn outside the refuge on BMGAFR. Recent literature has suggested habituation takes place regarding over-flights (Workman et al. 1992). Further research is needed on cumulative effects of military low level overflights and reproductive efforts over extended periods along with other natural elements such as drought.

Relevant new data should guide recovery efforts as more is learned about the species and its habitat. Chalmers and Barren (1974) believe sub-lethal effects of stress may be highly detrimental to the pronghorn's well-being. McNay (1980) reported that does with late fawns and does in late pregnancy were highly reactive to any form of harassment and that pregnant does moved out of a fawning area when cattle moved in.

Surveys are needed in Mexico comparing the estimated population size with the acreage of utilized habitat. These data might be useful in assisting managers in the U.S. to determine recovery strategies. There are fewer restrictions on airspace access in Mexico which allows for a greater chance of successfully completing aerial surveys. In the U.S., aerial surveys are requested to fit into military airspace schedules which makes scheduling difficult.

One recommendation in the CES 1992 report was accomplished on June 10, 1993 with the official designation of a National Biosphere Reserve which includes the Pinacate, the Gran Desierto de Altar, and the Santa Clara Delta. This Biosphere encompasses much of Sonoran pronghorn habitat in Mexico and also borders lands managed by CPNWR and OPCNM in the U.S. These lands are discussed in a report by CES (Montijo and Sanchez 1993) as part of regional planning for sensitive species such as Sonoran pronghorn.

Computer models are increasingly being used for simulating scenarios for population management which might be helpful with information gathered thus far on Sonoran pronghorns. Using population simulation models also offer a means of understanding population dynamics if sufficient data can be collected for use in the simulations. Pojar (in prep.) will offer methods for modeling pronghorn populations.

In Arizona and Wyoming, biologist use POP-II or POP-III computer programs (O'Gara and Yoakum 1992). Composition surveys and age data are converted to population estimates with these programs. Line transects or "total" counts are used to align population models. The model works partly with changes in ratios. Suggestions are made for utilizing the data received from aerial surveys.

## G. STRATEGY FOR RECOVERY

Since sufficient information is not available to state with certainty the present status of Sonoran pronghorns, a decline in numbers cannot be assumed. There may, in fact, be a slow increase occurring over time, or the population may have stabilized over the past 10 years, but data is not available to substantiate population growth. The large size of the presently known habitat (> 2 million ha) provides many obstacles to recovery efforts such as the effort needed to complete the survey and obtaining the entry into military exercise areas. A significant fact regarding recent surveys is that they were completed after two years of substantial rainfall following nine years of low precipitation.

Specific, testable hypotheses are necessary in attempts to make reliable and defensible conclusions. Evaluation of research hypotheses will provide guidance and critique for recovery efforts. The formation of an inter-agency committee, including appropriate professional members from research and scientific institutions and other related constituents, would help in steering future research planning

efforts. This group could be a “sub-group” Review Board directed by the CWG.

Work should proceed simultaneously on several aspects of Sonoran pronghorn recovery efforts. The CWG should coordinate with sub-groups, assigning them tasks such as investigating historical habitat or satellite telemetry. These sub-groups would gather information on a specific project from appropriate experts and report back to the CWG.

Strategies developed for each possibility of population status for pronghorns (declining, stable, or increasing) might provide a clearer path for managers to follow. Management goals should consider enhancement of genetic fitness and adaptability.

This plan lists the strategies presently believed necessary for Sonoran pronghorn recovery. The revision revisits areas where sufficient information has not been gained to understand limiting factors to the level where decisive management steps can be implemented.

These points are being re-addressed:

1. Limited information about home range, movements, and diet have been obtained, but little is known about habitat utilization. Unconfirmed sightings on the TON need follow up.
2. Revise population objectives and estimates.
3. Identify minimum viable population size necessary to delist the Sonoran pronghorn. (Viable population defined as one that maintains its vigor and its potential for evolutionary adaptation.)
4. Identify suitable transplant sites within historic range/habitat and determine number of animals that can be safely removed from donor populations and numbers that receiving habitat will support.

## II. RECOVERY

### A. OBJECTIVES AND CRITERIA

Objective: Downlisting.

The 1982 Recovery Plan states as its objective “Maintain existing population numbers and distribution of Sonoran pronghorn while developing techniques which will result in a U.S. population of 500 animals (average for a five year period) or numbers determined feasible for the habitat”. Obtaining significant new information and annual review of this revision should keep this objective flexible to reflect knowledge gained. Monitoring populations levels and recruitment rates periodically are crucial elements that should give managers data to direct further recovery efforts.

Populations have been estimated over the past eleven years at about 85-100 animals. This estimate originated from a series of radio telemetry flights conducted over several years. No specific recovery effort has been attributed towards this seemingly stable population level. Habitat protection due to federal ownership is probably one reason. Since the 1993 surveys showed 126 animals, it might appear that there was an increase in the population level. These two estimates are not comparable due to the fact that the two population estimates were not derived from the same methodology.

The 1982 Recovery Plan stated a recovery number of 300 animals. This figure was not based on a

substantial amount of life history information. Obtaining information on the ecology of this species is necessary before a viable population size can be determined. The goal of 300 animals may need to be revised to reflect significant new life history information relevant to present conditions for pronghorns.

Extrapolating the number of observed animals from the 1992 aerial surveys to a population estimate for the area surveyed was done with the Distance software statistical program. Population estimates of 256 (126 observed) in the U.S. and 313 (220 observed) in Mexico were thus calculated.

**Criteria:**

The Sonoran pronghorn will be considered for reclassification from endangered to threatened 1. when an estimated population of 500 animals has been reached and remains stable over a five year period or 2. when numbers are determined adequate to sustain the population through time. If the following actions are completed successfully downlisting to threatened is anticipated by the year 2002.

## B. NARRATIVE FOR RECOVERY ACTIONS

### 1. Maintain present populations

#### 1.1 Protect known habitat

- 1.11 **Prevent overgrazing by domestic livestock:** Active livestock grazing occurs on public lands around Ajo, Gila Bend, and the Tohono O'odham Nation. Any trespass livestock outside of permitted areas should be reported promptly to the appropriate agency for resolution. Sonoran pronghorn habitat within these active livestock areas will be identified for discussion regarding designation as special use areas.
- 1.12 **Evaluate present status and threats:** An on-going monitoring program tracking status of perceived threats such as predation, noise disturbance, increased human disturbance, etc. should be in place.
- 1.13 **Minimize human disturbance:** Seek ways to decrease amount of human presence in critical use areas such as fawning areas; off-road vehicles should be minimized.

#### 1.2 Monitor populations

- 1.21 **Conduct periodic range wide aerial surveys in U.S. and Mexico if requested;** Continue line transect surveys in order to have statistically correct, reliable, repeatable data to analyze for population estimates. Maintain updated methodology.
- 1.22 **Investigate unconfirmed sightings:** Unconfirmed sightings have been reported within the last few years northeast of Ajo in the vicinity of the Sand Tank and Saucedo Mountains; another sighting was reported north of Hickman Valley on the TON. Where sightings are verified, surveys may be required to verify current range and population numbers.
- 1.23 **Standardize observation reporting:** What observed, numbers, sex, date, time, location, behavior, observer's name and address.

#### 1.3 Establish emergency protocols for injured or sick animals.

- 1.31 Maintain updated veterinarian contact: The Phoenix Zoo veterinarian is presently the contact for injured or deceased pronghorns. Provide backup as necessary.
- 1.32 Keen necessary materials available for medical situations and/or salvage of specimen parts: The Phoenix Zoo will supply necessary materials for salvage of parts from carcasses.
- 1.33 Contact USFWS immediately of fatality/crisis situations Contact CPNWR

#### 1.4 Review all project proposals:

- 1.41 Submit project proposals to Review Board and CWG: A sub-committee made up of professionals or other elected persons will critique project proposals along with the CWG regarding recovery efforts.
- 1.42 Seek inter-agency involvement and cooperation: Inter-agency and intra-agency cooperation should be strengthened to increase funding and stronger work forces needed to enhance recovery.
- 1.43 Perform: submit actions that affect survival of Sonoran pronghorn to the Ecological Services Office.
- 1.44 Prepare implementation plan for each project: Each major recovery effort should be accompanied by a detailed action or implementation plan that explains what is to be done, how and by whom. Action plans will be written by the sub-groups in conjunction with the CWG.

#### 1.5 Determine taxonomic status

- 1.51 Examine uncompered specimens: Document in the literature and submit for review by the appropriate professionals comparisons of recent specimens to aid in taxonomic verification.
- 1.52 Document blood analysis: Blood samples which have been analyzed regarding subspeciation should be discussed and documented.
- 1.53 Document electrophoresis analysis: Analyses performed to date which will aid in taxonomic verification should be discussed and documented in the literature.
- 1.54 Review current literature on subject: The CWG and Review Board will stay updated regarding recent applicable literature which may contribute to recovery. The line transect method for aerial surveys is discussed in a 1993 publication on the Distance statistical program used with this method.
- 1.55 Maintain repository contacts: Keep contacts for repository up to date; this currently is the Smithsonian Institution in Washington D.C.

#### 1.6 Assist Mexico as requested

- 1.61 Determine national Biosphere status: The 1993 Biosphere designation covers much of Sonoran pronghorn habitat in Mexico. Assistance with recovery will be provided as requested; the management plan for the Biosphere discusses a regional approach to

conservation which incorporates CPNWR and OPCNM. Seek to provide for movement across political boundaries for pronghorns.

- 1.62 Conduct aerial/around surveys: The U.S. will continue with assistance as requested.
- 1.63 Provide funding Continue to support the goals of the Biosphere designation and provide funding assistance to enhance regional recovery efforts for Sonoran pronghorns.
- 1.64 Supply manpower: Provide as is available.

2. Establish additional herds of viable Sonoran pronghorns to reach an estimated population of 500 animals in the U.S.

2.1 Determine factors that limit population growth.

- 2.11 Define present range: Determine present range. Obtain information on key areas used for fawning, bachelor groups, nursery areas, areas of high, medium, and light use. Seek information from local hunters.
- 2.12 Determine preferred habitat: Determine areas preferred for each activity: fawning, movement corridors, bachelor groups, etc. and seasonality of these usages. Once these are determined, forage status of such areas should be evaluated. Satellite telemetry may helpful in making these determinations.
- 2.13 Determine relationship to water: Satellite tracking, remote sensing cameras, remote videos, and manned stations at water sources can provide information on water use, frequency, seasonal use of surface waters, predation, inter and intra-specific competition for evaluating need for artificial, ephemeral and/or permanent water sources. Metabolic studies to determine the need for water in free-ranging pronghorns should be conducted.
- 2.14 Determine natality, mortality, and recruitment rates: Continue studies to evaluate aspects of life history and limiting factors such as natality and mortality; radio telemetry can help provide information on recruitment.
- 2.15 Determine inter-specific and intra-specific competition: Evaluate impact of other species which interact with pronghorns such as coyote, javelina, deer, and golden eagles.
- 2.16 Determine optimum population composition, minimum herd size, and social behaviors of herds: Data for some ecological questions might best be evaluated over the course of a few decades, incorporating climatic factors and other long term cyclical and synergistic parameters.
- 2.17 Evaluate impact of factors believed to be limiting population growth
  - 2.171 Predator effects: Collect information on life history, distribution, and home range of predators.
  - 2.172 Effects of disease and parasites: Obtain information on health of pronghorns when captured for telemetry collaring and other circumstances when pronghorns are handled.

2.173 Impact of fences, highways: Highways may restrict pronghorn passage. Discussions regarding passage zones for pronghorns across the four-lane Highway 2 in Mexico between the two countries are proceeding. Fencing can be modified. CPNWR has fencing on the east and south boundaries; the southeast side has been removed. The U.S. needs to decide their position on whether to modify the south boundary fence to make it pronghorn passable or leave it as a 7 strand fence. Signing can be used for a pronghorn passage zone. Investigate pronghorn passage gates.

2.174 Impact of livestock grazing: Minimize livestock grazing within pronghorn habitat. Active livestock grazing occurs on public lands around Ajo, Gila Bend, and on the TON. Trespass livestock outside of permitted areas should be reponed promptly to the appropriate agency for resolution. Sonoran pronghorn habitat within these areas should be identified and discussed with the appropriate land management agency to provide optimum protection in fawning areas, movement corridors, seasonal forage areas, etc. The permitting agency should take necessary actions to resolve potential livestock conflicts.

2.1741 Grazed versus ungrazed areas: Investigate and evaluate forage differences between areas.

## 2.18 Radio telemetw

2.181 Determine applicability of satellite telemetry use and if economically feasible: use of satellite telemetry would eliminate need to schedule flights in between military exercises. Information should be received continuously. Night time surveillance might provide significant data on movement and behavior depending on coverage available. More data on predation and relationship to water could be gathered without the bias of noise and presence of planes.

2.1811 Experiment with satellite telemetw ~~investigate quality of coverage for Sonoran desert:~~ Investigate data from satellite telemetry over a significant period of time to determine if a sufficient amount of data is being collected and if it is of the quality necessary to answer management questions.

2.1812 Monitor and document svstematically: Conduct telemetry flights gathering information on a weekly basis.

## 2.2 Minimize effects of military activities

2.21 Identify critical use areas and seek to have military avoid these areas: Identify fawning, movement corridors, forage areas, etc. and seek optimum protection for such areas.

2.22 Seek to decrease military actions that adversely affect Dronahorn behavior: Strive for higher flight ceilings for training routes and minimize other military uses that impact Sonoran pronghorn.

2.23 Establish a noise monitoring program examining population growth rates relative to military presence and recreational usage: Evaluate individuals, group dynamics, and vehicular traffic by recreational users and military training routes over the refuge. CPNWR efforts to obtain a noise profile map of the refuge which might aid in understanding what

effect military overflight noise has on the refuge relative to topography, elevation and other aspects of the land should be continued. This map could be used in behavioral studies of wildlife, particularly reproductive success of Sonoran pronghorns.

- 2.24 Obtain noise profile map of Dronahorn habitat: In 1993, funding for Sonoran pronghorn investigations from the Marine Corp is being used to digitize topography in the eastern portion of the CPNWR in pronghorn habitat in preparation for having a noise profile map done in GIS format. All of pronghorn habitat needs to be included in this map. This map will give refuge managers concrete data in which to answer requests for changes in MTR's (military training routes) relative to location of wildlife resources on the refuge and areas of higher impact of sound reverberations (canyons where sound bounces back and forth) versus the valley floor where sound splays out. Soil makeup, vegetative cover, climatic factors, and many other variables may play a role in what sounds does in different areas. This map could help managers avoid potential conflicts with military scheduling and wildlife use areas.
- 2.25 Revise USAF-USFWS MOU to incorporate recovery needs: Avenues to share funding and direct research studies could be outlined in the Memorandum of Understanding which is due for revision in 1995.

### 2.3 Investigate historical range and habitat

- 2.31 Determine habitat evaluation techniques: Literature sources are available which provide guidelines for determining habitat evaluation techniques. These can be used as references for Sonoran pronghorns even though habitat requirements are different from the other four subspecies.
- 2.32 Determine habitat criteria for re-introduction: Further investigating life history and using what information has been learned thus far will be a starting point. Guidelines for other sub-species can be used.
- 2.33 Evaluate, and prioritize historical range and habitat for re-introduction sites: California Department of Fish & Game is involved in Sonoran pronghorn recovery efforts and has suggested re-introduction sites, including the Chuckwalla area, which has been discussed but never evaluated. Literature searches, agency discussions, and evaluations of the areas need to be initiated.
- 2.34 Acceptance by local community Determine position of community where action is to take place by information dissemination, meetings.
- 2.35 Investigate increasing number of pronghorns in presently used habitats: Sites already being inhabited such as west of the Mohawk Mountains, the Lechuguilla Desert, Tule Valley area, and Valley of the Ajo should be investigated. Studying the low population numbers in these areas will be important to whether or not these sites could support more pronghorns.
- 2.36 Determine habitat status at re-introduction sites:
- 2.361 Predator status: A review of predator status relative to pronghorns should be undertaken. Determine desired results and manage for these.
- 2.362 Fence status: Maintain fences.

- 2.363 Forage modification: Determine status of forage.
- 2.364 Water availability needs to match needs of captive reared animals: Determine if water available at release sites is sufficient.
- 2.37 Determine legal aspects of re-introductions: Work with local agencies and comply with legal responsibilities to provide for successful herd management.
- 2.38 Conduct information and education in proposed re-introduction sites: Provide communities at and near the release sites with information on the project in order to receive feedback.
- 2.4 Evaluate methods to increase population numbers and size
- 2.41 Captive breeding
- 2.411 Determine number and sex of selected animals: Select minimum number. If mortality occurs, replacement from the wild population could occur. Captive breeding would be initiated with the intention of returning individuals to the wild to augment present populations.
- 2.412 Decide type of Physiological monitoring to conduct: Decide what unknown factors of life history can be evaluated while in captive breeding.
- 2.413 Consider hand-raising for separate captive groups: Hand raising individuals might provide for intensive monitoring of physiological factors, maintaining a genetic stock, evaluating implications of captive habituations such as dependence on water, and for purposes of a permanently captive group.
- 2.42 Conduct population viability analysis: Explore conducting population viability analysis. Analysis will not be conducted if sufficient data is not available to make analysis meaningful.
- 2.43 Transplant
- 2.431 Selection criteria: Criteria for age, sex and herd size selection will need to consider least impact on host population and optimum chances for success for transplanted herd.
- 2.432 Capture: Past history of collaring efforts has given information to use regarding capture of the animals. Standardize protocol .
- 2.433 Holding: Information on holding requirements can be investigated from other subspecies and should be clearly decided upon prior to implementation.
- 2.434 Transportation: Research successful methods and establish protocol before program begins.
- 2.435 Release: Insure that monitoring and follow-up is implemented on regular basis as stated in the management plan.



## **2.5 Monitor new populations:**

### **2.51 Habitat status**

**2.511 Population:** Expectations of mortality and natality rates should be decided prior to release with appropriate management steps.

**2.512 Predation:** Acceptable levels of losses should be decided and relevant management steps to use for unacceptable levels.

**2.513 Threats:** Management steps for expected and unexpected threats should be decided.

**2.514 Behavior, habitat use:** Document and evaluate.

## **III. IMPLEMENTATION PROCESS**

Many individual implementation plans are needed for the various recovery steps listed above as each will be an involved project within itself. These implementation plans will be the source and location for specific, measurable objectives that each recovery project will have in which the CWG can track progress. The Implementation Plans will list actions needed to meet the objective of each project.

The CWG will decide which projects need implementation plans and they along with a sub-group will stepdown specific recovery steps, i.e. satellite telemetry or investigating historical habitat. Sub-groups will contact the appropriate experts relative to a project, gather information, and bring this to the CWG for review.

Discussion and a listing for management plans specifically for pronghorns, their habitat, and enhancement of recovery will soon be available (Yoakum in press) and might be valuable in Sonoran pronghorn recovery.

IMPLEMENTATION SCHEDULE

Priority #	Task #	Task Description	Task Duration	Responsible Party		Cost Estimates (\$000)		
				FWS Reg.	OTHER Progr.	FY1995	FY1996	FY1997
2	1.11	overgrazing	ongoing		BLM, NPS	10	10	10
2	1.12	present threats	ongoing	2	<b>BLM, NPS</b>	50	50	50
2	1.13	disturbance	ongoing	2		10	10	10
2	1.21	aerial surveys	6	2	Refuges CWG			20
3	1.22	studies	ongoing		CWG			
3	1.23	observations	ongoing		CWG			
3	1.31	veterinarians	ongoing		CWG			
3	1.32	salvage equip.	ongoing		CWG	5	5	5
2	1.33	contact-crisis	ongoing		CWG			
3	1.41	Review Board	ongoing		CWG			
2	1.42	Inter-agency	ongoing		CWG			
2	1.43	Section 7	ongoing	2				
2	1.44	Implementation	ongoing	2	CWG			
3	1.51	specimens	3	2	Smi	5	5	5
2	1.52	blood analysis	3	2	For	10	20	20
2	1.53	electrophoresis	2		For			
2	1.54	liter. review	ongoing	2	CWG			

Priority #	Task #	Task Description	Task Duration	Responsible Party		Cost Estimates (\$000)		
				FWS Req.	OTHER Prosr.	FY1995	FY1996	FY1997
2	1.55	'repository	ongoing		Smi			
2	1.61	Biosphere	15	2	<b>CWG</b>			
2	1.62	surveys	6	2	CWG			20
2	1.63	funding	ongoing	<b>2</b>	CWG, USAF	50	50	50
3	1.64	manpower	ongoing		CWG			
2	2.11	define range	5	2	CWG, USAF			
2	2.12	preferred habit	5	2	CWG	50	50	50
2	2.13	water needs	15	2	<b>CWG</b>	50	50	50
2	2.14	natal, mort, recr	5	2	CWG	80	80	80
3	2.15	competition	15	2	CWG	80	80	80
3	2.16	pop.composition	15	2	CWG	10	10	20
2	2.17	limiting factor	15	2	CWG	60	60	60
2	2.171	predator effect	15	2	CWG	80	80	80
3	2.172	disease effects	ongoing	2	CWG	40		40
3	2.173'	impact of fence	5	2	CWG		40	
<b>3</b>	2.174	impact of grazi	15	2	CWG	<b>50</b>	<b>50</b>	<b>50</b>
<b>2</b>	2.181	satellite tele	5	2	Leg, CWG	80	80	80
<b>3</b>	2.21	military avoid	ongoing	2	Leg, CWG	80	80	80
<b>3</b>	2.22	decr.mili.actio	ongoing	2	Leg, CWG			

Priority #	Task #	Task Description	Task Duration	Responsible Party		Cost Estimates(\$000)		
				FWS Reg.	OTHER Progr.	FY1995	FY1996	FY1997
3	2.23	long.term.monit	ongoing	2	Leg, CWG	100	100	100
3	2.24	noise prof.map	5	2	Leg, CWG			
3	2.25	revise USAF MOU	5	2	USAF, CWG			
2	2.31	habitat eval..	5	2	CWG	5	5	5
3	2.32	habitat <b>criter.</b>	5	2	CWG	5	5	5
3	2.33	<b>histor.range</b>	5	2	CWG	20	20	20
3	2.34	acceptance <b>comm</b>	ongoing		CWG			
3	2.35	pres.used habit	ongoing	2	CWG	20	20	20
3	2.36	habitat status	ongoing	2	CWG	50	50	50
3	2.37	legal aspects	ongoing	2	CWG	5	5	5
3	2.38	education re-in	ongoing		CWG	5	5	5
3	2.41	captive breed.	?	2	CWG			
3	2.42	POP. viab.anal..	?	2	CWG			
3	2.43	<b>transplant</b>	?	2	CWG			
3	<b>2.511</b>	monitor pop..	ongoing	2	CWG		40	40
3	2.512	monitor pred.	ongoing	2	CWG		50	50
3	<b>2.513</b>	monitor threats	ongoing	2	CWG		50	50
3	<b>2.514</b>	monitor <b>hab.use</b>	ongoing	2	CWG		80	80

IMPLEMENTATION SCHEDULE  
Definitions and Acronyms

Priorities in column one of the Implementation Schedule are assigned as follows:

1. Priority **1** - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
2. Priority **2** - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.
3. Priority **3** - All other actions necessary to meet the recovery objective.

**Key to Acronyms used in the Implementation Schedule**

BLM - Bureau of Land Management  
CWG - Core Working Group (working on recovery efforts)  
For - **USFWS** National Fish and Wildlife Forensics Lab  
Leg - Military Legacy funding  
NPS - National Park Service  
Smi - Smithsonian Institution, Wash. D.C.  
USAF - United States Air Force

#### IV. LITERATURE CITED

- Arizona Game and Fish Department. 1981. The Sonoran Pronghorn. Special Report Number 10. **Ariz.** Game and Fish Dept. Phoenix, **Ariz.** 55 pp.
- \_\_\_\_\_. 1985 Interim Report on the Sonoran **Pronghorn** Antelope. (***Antilocapra americana sonoriensis***) **Oct.** 1983 - March 1985. Phoenix, Ariz. 57 pp.
- Ballou, J. D., T. J. **Foose**, R. C. Lacy, and Seal, U.S. 1989. Florida Panther Population Viability Analysis and Recommendations. USFWS Coop Contract # 14-16-0004-89-911.51 pp.
- Beale**, D. M. and A. D. Smith. 1970. Forage use, water consumption, and productivity of pronghorn antelope in Western Utah. **J. Wildl. Manage.** **34(3):570-582.**
- Brown, D. E. 1982. Biotic communities of the American southwest United States and Mexico. Desert Plants. 4 pp.
- Burnham**, K. P., D. R. Anderson, and J. L. Laake. 1980. Estimation of density from line transect sampling of biological populations. **Wild.Monogr.** 72. 202 pp.
- Burt, W. H. 1938. Faunal relationships and geographic distribution of mammals in Sonora, Mexico. **Publ.** No. 39, Mus. **Zool.**, Univ. **Mich.**
- Cabeza Prieta** National Wildlife Refuge Management Plan. 1980. School of Renewable Nat. **Res.**, Univ. of **Ariz.** Tucson.
- Cabeza Prieta** National Wildlife Refuge. Updated Planning Needs Assessment. 1986. **Ajo**, Ariz.
- Carr**, J. N. 1970. Endangered species investigation. Sonoran pronghorn. Ariz. Game and Fish Dept. Phoenix, **Ariz.** **13 pp.**
- \_\_\_\_\_. 1972. Endangered species investigation. Sonoran pronghorn. Ariz. Game and Fish Dept., Phoenix, **Ariz.** **8 pp.**
- \_\_\_\_\_. 1973. Endangered species investigation. Sonoran pronghorn. Ariz. Game and Fish Dept., Phoenix, **Ariz.**
- Chalmers, G. A. and **M.** W. Barrett. 1974. Some problems associated with chasing pronghorns. **Pronghorn Antelope Workshop Proc.** 6: 13-14.
- Cherkovich, G. **M.**, and S. K. Tatoyan. 1973. Heart rate (radiotelemetric registration) in macaques and baboons according to dominant-submissive rank in a group. **Folia Primatol.** **20:265-273.**
- Corneli**, P. S., B. Von **Gunten Moran**, and B. W. **O'Gara**. 1984. Pronghorn fawn mortality on the National Bison Range. Pronghorn Antelope Workshop **Proc.** **11:41-48.**
- deVos**, J. C. and J. E. Scott. 1988. Sonoran pronghorn progress report. Ariz. Game and Fish Dept. Phoenix, **Ariz.** **21 pp.**
- Ellis, J. E. 1970. A computer analysis of fawn survival in the pronghorn antelope. Ph.D. Thesis, Univ. **Calif.**, Davis. 70 pp.
- Franklin, I. R. 1980. Evolutionary change in small populations. Pages 35-149. **in** M. Soule and B. Wilcox, ed., Conservation biology: An evolutionary-ecological perspective. Sinauer Assoc., Sunderland, Mass.

- Frick**, C. 1937. Homed Ruminants of North America. Bull. Am. Mus. Nat. Hist. 69: 1-699.
- Goldman, E. A. 1945. A new pronghorn from Sonora. **Proc. Biol. Soc.** Wash. 58: 3-4.
- Hall, E. Raymond and Keith R. Kelson. 1959. The **mammals** of North **America**. Ronald Press, New York, 2 volumes.
- Hastings, J. R. and R. **M.Turner**. 1980. The Changing Mile. Sec. Ed. Univ. **Ariz.** Press, Tucson, Ariz. 317 pp.
- Hickman, J. C. 1993. The Jepson Manual. Higher Plants of California. Univ. **Calif.** Press, Los Angeles. pp. **37-44**.
- Hughes, K. S. and N. S. Smith. 1990. Sonoran pronghorn use of habitat in southwest Arizona. Final Report 14-16-009-1564 RWO **#6**. AZ Coop Fish & Wildl. Research Unit, Tucson, AZ. 58 pp.
- Hoffmeister, D. F. 1986. Mammals of Arizona. Univ. of **Ariz.** Press, Tucson, **Ariz.** 602 pp.
- Hoover, R. L., C. E. Till, and S. Ogilvie. 1959. The antelope in Colorado. Tech. Bull. 4. Colo. Dep. Game and Fish, Denver. 110 pp.
- Homocker, M. G. 1970. An analysis of mountain lion predation upon mule deer and elk in the Idaho Primitive Area. Wildl. Monogr. 21. 39 pp.
- Howard, V. W., J. L. Holechek, R. D. **Pieper**, K. Green-Hammond, M. Cardenas, and S. L. **Beasom**. 1990. Habitat requirements for pronghorns on rangelands **impacted** by livestock and net wire in east central New Mexico. Agric. Exp. Sta. Bull. 750, N. M. State Univ., Las **Cruces**. 48 pp.
- Kindschy, R. R., C. Sundstrom, and J. D. Yoakum. 1982. Range/wildlife habitats in managed rangelands - The Great Basin of southeastern Oregon: Pronghorns. U.S. Dep. Agric., Pac. NW Forest Range Exp. Sta., Portland, Ore. Gen. Tech. Rep. PNW - 145. 18 pp.
- Kitchen, D. W. and B. W. **O'Gara**. 1982. Pronghorn (*Antilocapra americana*). Wild Mammals of North America. John Hopkins **Univ.Press**
- \_\_\_\_\_. 1974. Social behavior and ecology of the pronghorn. Wildl. Monogr. 38. 96 pp.
- Laake**, J. L., S. T. **Buckland**, D. **R.Anderson**, and K. **P.Burnham**. 1992. draft pub. Distance Sampling: Abundance Estimation of Biological Populations. Colorado Cooperative Wildlife Research Unit. Colo. State Univ. **Fort** Collins, co. 54 pp.
- McKee, **J.E.**, and H.W. Wolf. 1963. Water quality criteria. State Water Quality Control. Sacramento, **Calif.** Pub. 3-4. 548 pp.
- McNay**, M. **E.** 1980. Causes of **low** pronghorn **fawn:doe** ratios on the Sheldon National Wildlife Refuge, Nevada. M.S. Thesis. Univ. Mont., Missoula. 128 pp.
- Mearns**, E. A. 1907. Mammals of the Mexican boundary of the United States. Pt. i, families Didelphidae to Muridae. Bull. U.S. Nat. Museum, **56:XVT530**, 13 April.
- Moen**, A. N., M. A. **DellaFera**, A. L. **Hiller**, and B. A. Buxton. 1978. Heart rates of white-tailed deer fawns in response to recorded wolf howls. Can. J. Zool. **56:1207-1210**.
- Monson**, G. 1968. The Desert Pronghorn. Desert Bighorn Council Transactions. April IO-12 **Las** Vegas, Nev. 63-

Montijo, A. B. and C. **C.Sanchez**. 1993. 'Propuesta **Para** Decretar **La** Reserva De **La** Biosfera El Pinacate y Gran Desierto de Altar, Municipios de Puerto **Peñasco**, General **Plutarco Elias Calles** y San Luis Rio Colorado, Sonora, Mexico". Centro **Ecologico** de Sonora, **Hermosillo**, Sonora, Mexico. 169 pp.

Natural Resource Management Plan, 1986. Luke Air Force Base, Phoenix, **Ariz.**

Nelson, F. W. 1925. Status of the pronghorn antelope, 1922-1924. U. S. Dep. Agric. Bull. 1346. 64 pp.

Nowak, R. **M.** and J. L. **Paradiso**. 1983. Walker's Mammals of the World. 4th. Ed. Vol. II. John Hopkins **Univ.** Press, Baltimore, MD, pp. 1230-1232.

O'Connor, J. 1939. Game in the Desert. The Derrydale Press, N.Y.

**O'Gara**, B.W. 1978. *Anrilocapra americana*. Am. **Soc.** Mammal. Mammalian **Species**. No. 90, 7 pp.

\_\_\_\_\_. and J. D. Yoakum. 1990. Additional capture methods and habitat suitability criteria for **pronghorn translocations**. Pronghorn Antelope Workshop **Proc.14:5** 1-62.

\_\_\_\_\_. 1992. Pronghorn Management Guides. 15th. Bien. Pronghorn Antelope Work., Rock Springs, WY.

Paradiso, J. L. and R. W. Nowak. 1971. Taxonomic status of the Sonoran Pronghorn. J. **Mamm.** **52(4)**: 855-858.

Phelps. J.S. 1974. Endangered Species Investigation. Sonoran Pronghorn habitat in Arizona. **Proc.** Bien. Pronghorn Workshop. **8:70-77**.

\_\_\_\_\_. 1978. Sonoran **pronghorn** in Arizona. Pronghorn Antelope Workshop **Proc.8:70-77**.

Pojar, T. M. In prep. The use of population models. Chapter in J. D. Yoakum and B. W. **O'Gara**. Ecology and management of the pronghorn. Wildl. Manage. Inst., Wash. D.C.

Reynolds, T. D. 1984. Daily summer movements, activity patterns, and home range of pronghorn. Northwest Science. 58: 300-311.

**Seton**, E. T. 1937. Lives of game animals. The Literary Guild of America, Inc., New York. **3:41** 1-467.

**Sundstrom**, C., W. G. Hepworth, and K. L. Diem. 1973. Abundance, distribution, and food habits of the pronghorn. Wyo. Game and Fish **Comm.**, Cheyenne. Bull. 12. 61 pp.

Thompson, R. D., C. V. Grant, E. W. Pearson. and G. W. Comer. 1968. Cardiac response of starlings to sound: effects of lighting and grouping. Am. J. Physiol. **214:41-44**.

Trainer, C. E., M. J. Willis, G. P. Keister Jr., and D. P. **Sheely**. 1983. Fawn mortality and habitat use among pronghorn during spring and summer in southeastern Oregon, 1981-82. Ore. Dep. Fish and Wildl., Portland. Wildl. **Res.** Rep. 12. 117 pp.

Udy, J.R. 1953. Effects of predator control on antelope populations. Ut. Dep. Fish and Game. Salt Lake City. Pub. 5. 48 pp.



- Wagner, F. H. 1978. Livestock grazing and the livestock industry. P. 121-145 in H. P. Brokaw, ed. Wildlife and America. U. S. Govt. Print. Off., Wash. D. C. 532 pp.
- Wald, J. and D. **Alberswerth**. 1989. Our ailing public **rangelands**. Nat'l. Wildl. Fed., Wash. D. C. 15 pp.
- White, G. C., R. M. Bartmann, L. H. **Carpentter** and R. A. Garrott. 1989. Evaluation of aerial line transects for estimating mule deer densities. J. **Wildl. Manage.** **53(3):625-635**.
- Workman, G. W., T. **D.Bunch**, J. **W.Call**, R. C. Evans, L. D. S. **Neilson**, E. **M.Rawlings**. 1992. Sonic boom and other disturbance impacts on **pronghorn antelope** (**Antilocapra americana**). Air Force Contract: **F42650-87-C-0349**, Utah State Univ. Logan, Utah. 67 pp.
- Wright, R. L. and J. C. **deVos** Jr. 1986. Final Report on Sonoran Pronghorn Status in Arizona. **Ariz.** Game and Fish Dept. Phoenix, Ariz. 132 pp.
- Yoakum, J. D. and B. W. **O'Gara**. in prep. Wildlife Management Plans. Chapter in . Ecology and management of **the** pronghorn. Wildl. Manage. Inst., Wash. D. C.
- \_\_\_\_\_. 1978. Pronghorn. Pages 103-121 in J. L. Schmidt and D. L. Gilbert, **eds.** Big game of North America: Ecology and management. Stackpole Books, Harrisburg, Pa.
- \_\_\_\_\_. 1990. Food habits of the pronghorn. Pronghorn Antelope Workshop **Proc.** 14: 102-110.