BIOLOGICAL ASSESSMENT FOR SONORAN PRONGHORN (~~Antilocapra~~ americana sonoriensis) ON THE BARRY M. GOLDWATER RANGE IN RELATION TO WEAPONS TACTICS INSTRUCTOR TRAINING AT MARINE CORPS AIR STATION YUMA

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INTRODUCTION

The U.S. Marine Corps conducts a Weapons Tactics Instructor (WTI) Course on the Barry M. Goldwater Range twice annually. This course includes the use of (1) selected ground locations and roads by Marine troops and vehicles, and (2) selected low level flight corridors by fixed wing fighter and attack aircraft, and helicopter gunships and transports. Some probability exists that these military training activities may affect the Sonoran pronghorn antelope (Antilocapra americana sonoriensis); a federally endangered species whose present range in the United States is limited almost exclusively to parts of the Goldwater Range. The Sonoran pronghorn antelope are found primarily within the Cabeza Prieta National Wildlife Refuge, which is overlain by the Goldwater Range.

This Draft Biological Assessment addresses the potential impacts of the Spring 1988 WTI Course on the Sonoran pronghorn antelope, and presents proposed measures to minimize and mitigate adverse effects of that action on this species. This draft document is submitted by the U.S. Marine Corps/U.S. Navy to the U.S. Fish and Wildlife Service (USFWS) for review under Section 7 of the Endangered Species Act.

The findings of this Biological Assessment specify that there is a low probability that the WTI Course will place the Sonoran pronghorn antelope in any significant jeopardy. This conclusion is based on the facts that:

- All ground activities will occur in areas of previous surface disturbance that are out of or on the periphery of the Sonoran pronghorn's primary habitat (i.e., no new disturbance of primary habitat will occur).

- Based on the relatively low numbers of low level flights scheduled and the dispersed and small nature of the Sonoran pronghorn population, there is a very low probability of critically close encounters between low flying aircraft (especially helicopters) and Sonoran pronghorns with high, apparent vulnerabilities (e.g., pregnant does nearing fawning or does with fawns less than one week old).

- There is no apparent evidence that infrequent, close encounters with low flying aircraft cause any lasting detrimental effects in apparently healthy Sonoran or other American pronghorns.

The U.S. Marine Corps recognizes the importance of protecting the Sonoran pronghorn antelope and the need to be responsive to effective management efforts on behalf of this species. Accordingly a number of changes have been scheduled in the Spring 1988 WTI Course, at the request of the U.S. Fish and Wildlife Service, to help minimize any adverse effects that course activities may pose for the species. Further, the Marine Corps is making funding available, for 1988, to the U.S. Fish and Wildlife Service to be used, at the discretion of the Service, for research that will facilitate the protection and recovery of this endangered species. The Marine Corps will strive to provide continued support and funding to assist management of the Sonoran pronghorn and its habitat in the future.

PURPOSE OF WEAPONS AND TACTICS INSTRUCTOR COURSE

Marine Aviation Weapons and Tactics Squadron One (MAWTS-1) conducts the WTI Course which utilizes the airspace and selected ground locations within the Barry M. Goldwater Range for combat training exercises. The WTI Course provides graduate level training in Marine aviation weapons and tactics. The course syllabus includes approximately six weeks of intensive academics, command and control integration, and flight instruction. The objective is to graduate flight officers who are (1) fully qualified in their warfare specialty, (2) can plan and execute integrated missions, and (3) have the experience and knowledge necessary to conduct an effective and comprehensive aircrew training program for their respective squadrons. Conducted biannually, the WTI Course is designed to provide one WTI or WTI aircrew per squadron or unit per year so that service-wide capabilities in advanced aviation weapons and tactics are enhanced. In addition to Marine aviators, WTI graduates include U.S. Navy, Army, and Air Force flight crews. Marine officers from infantry and ground supporting arm units also attend the course to ensure appropriate interfacing between air and ground units.

The course is conducted in three phases: academic phase, flight phase, and the final exercise. The academic phase is divided into a week of generic instruction on the threat and contingencies, a week of fixed wing, rotary wing (helicopter), and command control and common communications instruction, and a final week of specific instruction on each particular warfare speciality. The flight phase, which begins the fourth week of the

course, consists of one week of specific weapons and tactics employment for each type of aircraft or Marine Air Command Control Squadron agency, a second week of fixed wing and rotary wing common flight orientation, and a third week of integrated flight evolutions encompassing all facets of Marine aviation. The last week of the course is set aside for a final exercise in which WTI students plan, execute and debrief integrated missions in a sophisticated threat environment.

USE OF THE BARRY M. GOLDWATER RANGE

The Goldwater Range is the only range facility in the United States where WTI training can occur. The Range provides:

- An adequate amount of air and land space to permit full training use of the capabilities of modern military aircraft against realistic threat scenarios;
- Sharply varying topography which, when combined with sophisticated anti-aircraft threats that can be deployed within the terrain base, poses valuable challenges to aircrew navigation and tactical skills;
- Designated live-fire target areas (in R2301E) that simulate realistic military objectives (such as airfields and railroad yards); and
- The West Coast TACTS Range which provides full flight data telemetry for air combat maneuvering exercises.

This combination of features and the remoteness of the Goldwater Range are necessary to achieving the WTI Course objectives while not risking the public and military safety hazards that would be presented at other smaller range facilities.

DESCRIPTION OF PROPOSED ACTION

Type of Training

WTI activities on the Goldwater Range will involve air and ground operations. Air operations will, at various times, utilize the airspace designated as R2301 W, R2301 E, R2304, and R2305. Ground operations, with two exceptions, will occur at selected sites within the Yuma segment of the Range but outside of the Cabeza Prieta National Wildlife Refuge. The ground exceptions will be a forward arming and refueling point (FARP) at the abandoned Stoval Airfield and an Air Support Radar Team (ASRT) site near North Tactical Range, both in the Gila Bend segment.

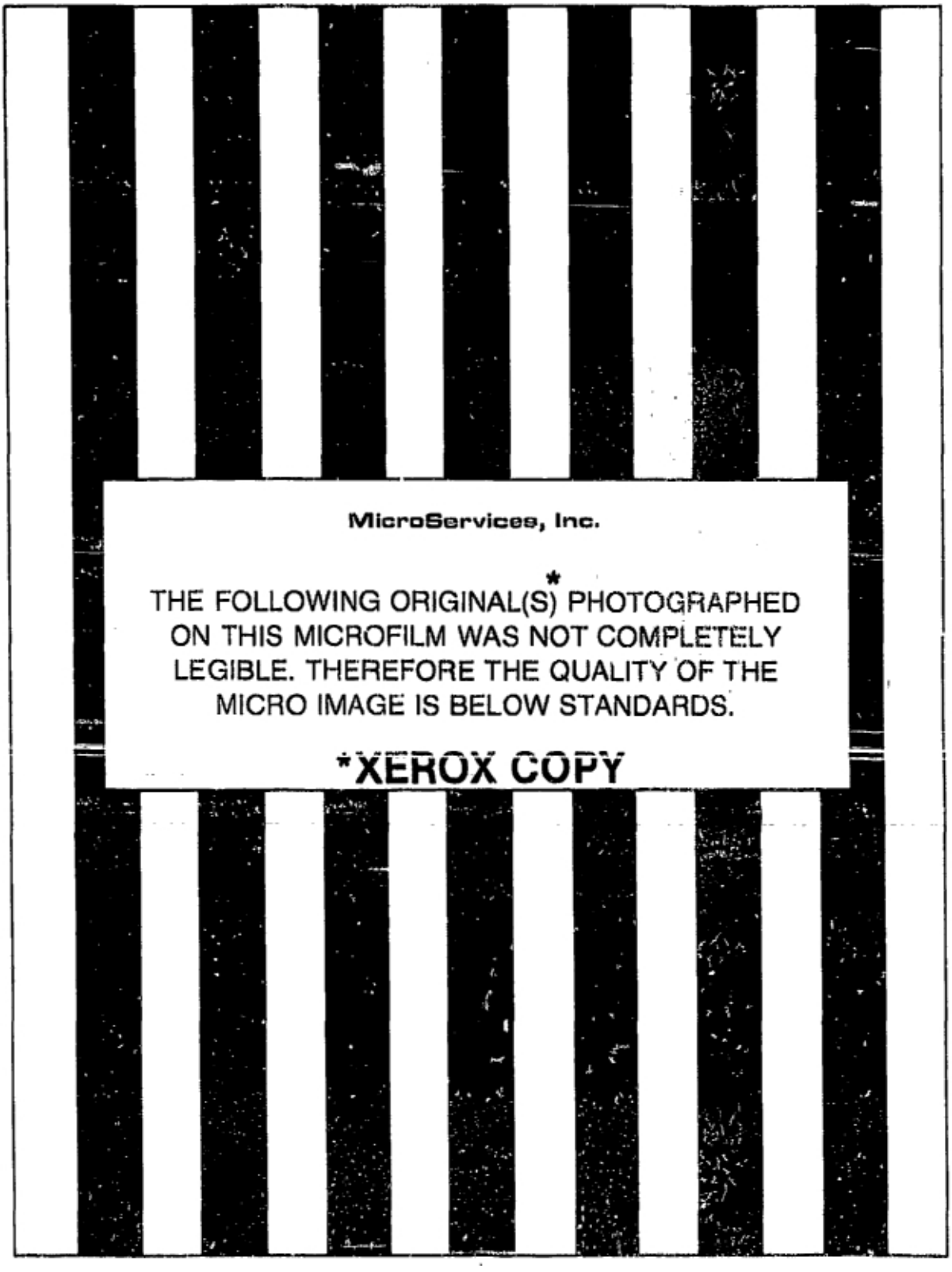
Air Operations--Fixed Wing

Fixed wing flight operations for the Spring 1988 WTI Course will begin on 13 March 1988 and end on 6 April 1988. Fixed wing low level operations will be conducted down to 200 feet above ground level. Planned low level flight corridors for fixed wing operations are shown on Figure 1.

The corridors shown represent the options available to WTI students. The actual flight intensity within each corridor will depend on the mission needs of the particular flight evolution. WTI students will determine these needs and select routes accordingly. Some corridors may not be selected at all. The flight schedule for low level fixed wing operations is shown in Table 1.

Fixed wing types potentially involved in low level operations include F18, A6, EA6, RF4, A4, F16, F21 and F4 aircraft. The air speeds of these aircraft at low levels will vary, but generally will exceed 400 knots, but will remain subsonic.

The series of flights that are scheduled are training evolutions that increase in mission complexity. The last three missions scheduled are final exercises.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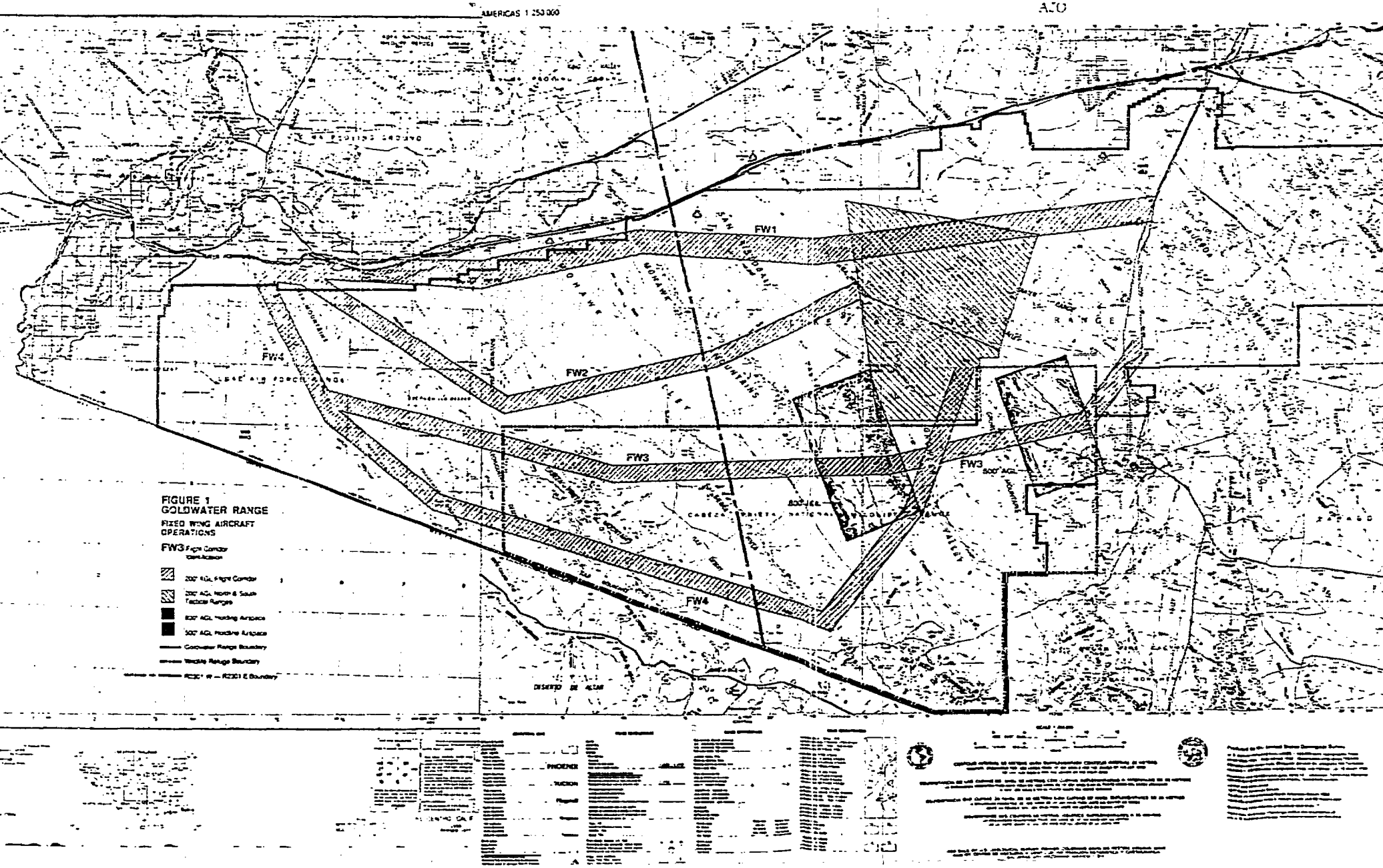
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FW1
FW2
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FW3
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FIGURE 1
GOLDWATER RANGE
FIXED WING AIRCRAFT
OPERATIONS
FW3 Flight Corridor
Identification
200' AGL Flight Corridor
200' AGL North & South
Tactical Ranges
500' AGL Holding Airspace
500' AGL Holding Airspace
Goldwater Range Boundary
Wildlife Refuge Boundary
R2301 W — R2301 E Boundary

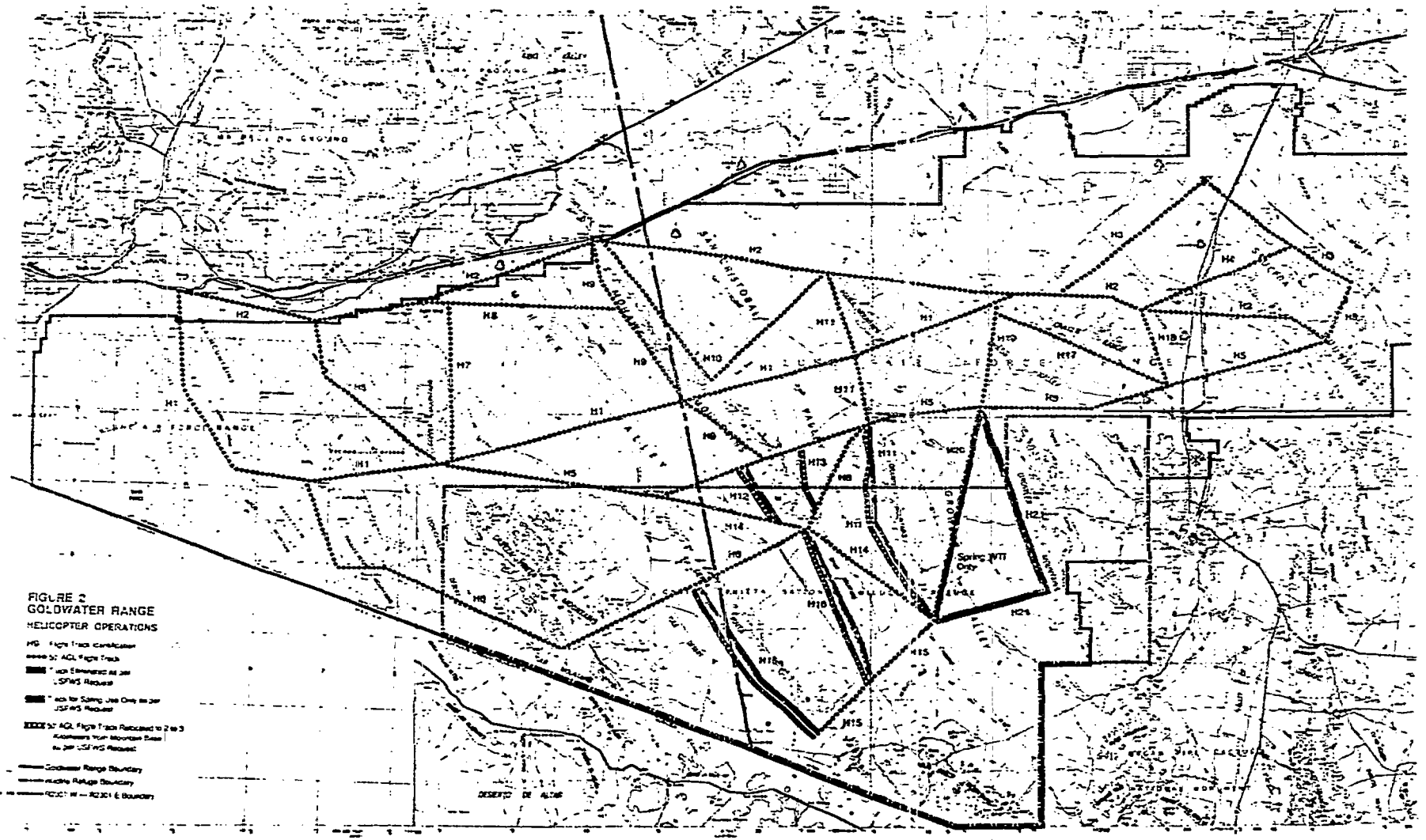
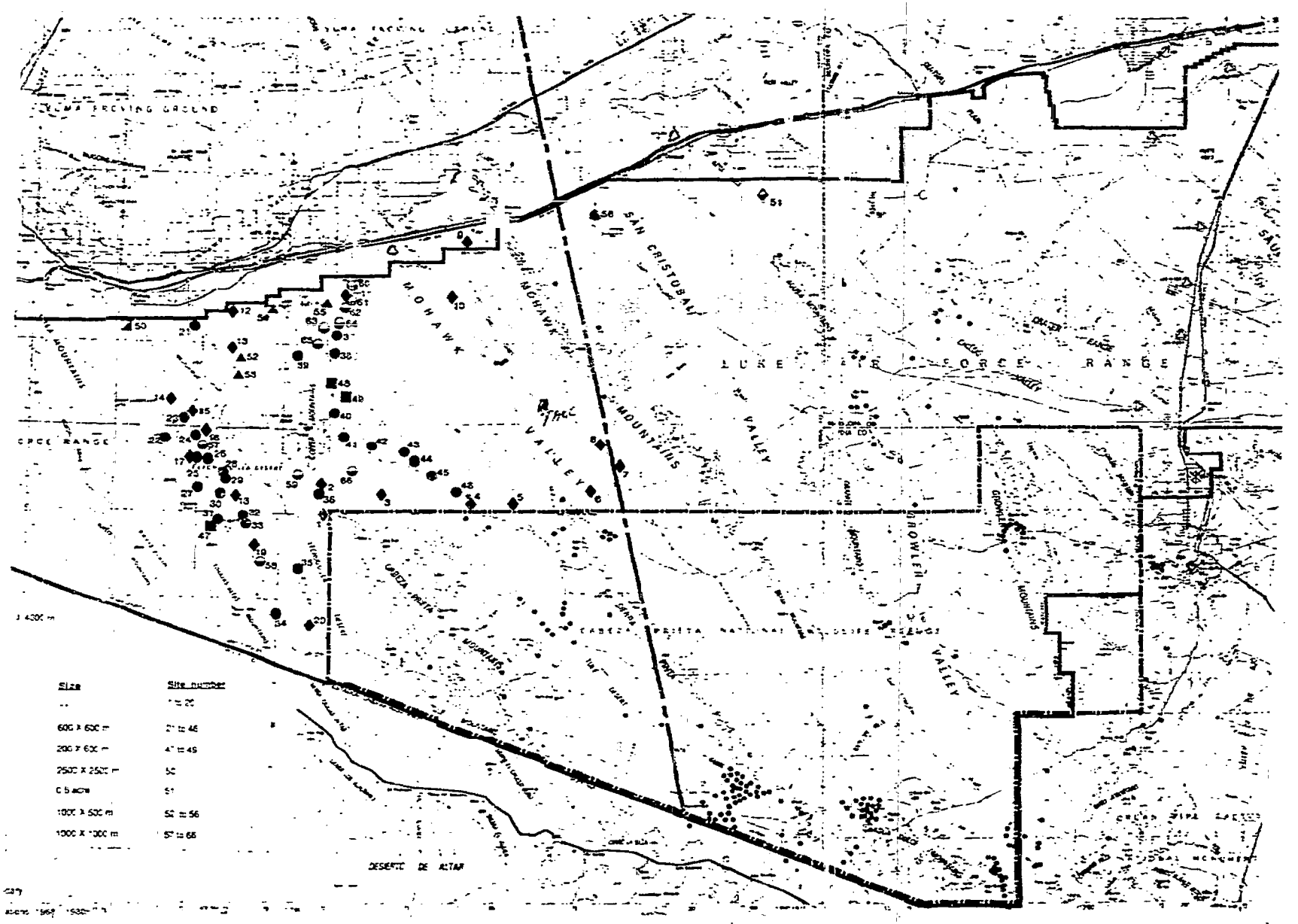


FIGURE 2
GOLDWATER RANGE
HELICOPTER OPERATIONS
Goldwater Range Boundary
Wildlife Refuge Boundary
PHOENIX
TUCSON


LUKE AIR FORCE RANGE
MOHAWK VALLEY
SAN CRISTOBAL VALLEY
HOWLETT MOUNTAINS
DESERTO DE ALTAR
Size
Site number
600 X 600 m
200 X 600 m
2500 X 2500 m
0.5 acre
1000 X 500 m
1000 X 1000 m

The purpose of the ground units is to support the flight phase of the WTI course. The locations selected for deployment of these units are those necessary to achieve the course training objectives. Not all of the sites identified will be used simultaneously during the WTI Course. Some may not be used at all, but all are considered to be available options for the exercise. All of the selected sites have been used for previous WTI and/or other USMC operations. The WTI schedule specifies that only 15 of the 19 possible stinger sites; 3 of the 7 possible Hawk sites; and 1 of the 3 possible EWC sites will be used at any one time.

Ground units will be deployed on the Range for 28 days, including all of the flight phase of the course. Ingress and egress to/from the sites and movement between sites will occur along designated use roads. No vehicle travel will occur outside of the designated ground unit sites or off of designated use roads.

TAXONOMY OF THE SONORAN PRONGHORN

The pronghorn (Antilocapra americana) is often referred to varyingly as American pronghorn, pronghorn antelope, antelope, or American pronghorn antelope. In actuality, the pronghorn is not a true antelope, but belongs to a totally different family, Antilocapridae, than the true, Old World antelopes which belong to the family Bovidae. The family Antilocapridae is known only from North America and has existed at least since the Miocene epoch (10 to 25 million years ago) (Cockrum 1981). Today, the family is represented on the planet by a single species, Antilocapra americana, which like its fossil progenitors, is known only from North America.

Presently there are five recognized subspecies of Antilocapra americana: A. a. americana, A. a. mexicana, A. a. oregona, A. a. peninsularis, and A. a. sonoriensis. A. a. americana occurs in eastern California, south to northern Baja California, Nevada, southern Idaho, Utah, northern Arizona, most of New Mexico, Colorado, Wyoming, southern Alberta, southern Saskatchewan, southwest Manitoba, North and South Dakota, Kansas, western Oklahoma, northwest Texas, and extreme western Minnesota and Iowa (Hall and Kelson 1959). A. a. americana is the typical, most common and widespread of the five subspecies. In contrast, the other four subspecies are much more restricted in distribution and exist in much smaller numbers. A. a. mexicana occurs east of the

Colorado River, south of the Mogollon Plateau, and north of extreme southwest Arizona eastward through southwestern New Mexico, most of Texas and south into the Mexican states of Sonora, Chihuahua, Coahuila, Nuevo Leon, Tamaulipas, Durango, Zacatecas, and San Luis Potosi. A. a. oregona occurs in extreme eastern Oregon and Washington. A. a. peninsularis is known only from Baja California, and A. a. sonoriensis is known only from extreme southern Arizona and northwestern Sonora, Mexico (Hall and Kelson 1959).

Statistical definition of a subspecies requires that measurements of at least 15 specimens of the same age and sex from a given locality should be compared with a similar number of specimens from a different locality (i.e., geographic region). If the measurements (e.g., balsilar length, nasal length, orbital width, zygomatic width, palatal breadth, and greatest nasal width) show statistical differences between the two sample populations, there is taxonomic justification for considering the two populations to be different at the subspecific level. Other factors that may be considered by taxonomists in defining subspecies include color, overall body size, and the size of soft body parts (e.g., ear or tail length). However, many factors may contribute to variations in such measurements including shifts in gene frequencies, variations in microhabitats, and variations in available nutrient sources (Cockrum 1981).

The original description of A. a. sonoriensis as a distinct subspecies was based on a pair of female pronghorn skulls, one taken on 11 December 1932 southwest of Hermosillo, Sonora, Mexico, and the other from Camp Crittendon west of Sonoita, Santa Cruz County, Arizona (Goldman 1945 In Cockrum 1981). The Hermosillo specimen is the type specimen for the subspecies and the Camp Crittenden specimen shares some of the characteristics of the type specimen. Cockrum's (1981) examination of the type specimen and four other specimens from near Caborca, Sonora, Mexico indicated that these specimens of A. a. sonoriensis differed more from Goldman's type specimen of the subspecies than the type specimen differs from pronghorn from northern Arizona. It is Cockrum's opinion, therefore, that the differences between known specimens of A. a. sonoriensis and specimens of other subspecies of A. americana are not sufficient to warrent subspecific designation to populations of pronghorn in northern Sonora and southern Arizona. Cockrum further suggests that the populations from which the few known specimens of A. a. sonoriensis came probably represent a series of morphologically differing local populations that could be condensed into A. a. mexicana (Cockrum 1981). On the other hand, Cockrum points out that specimens of pronghorn from the southern

part of the species' range tend to be paler in color, which led Mearns (1907) to designate such pale specimens as A. a. mexicana despite the fact that there appears to be a geographic mosaic of distribution of morphological characteristics over which a north-south cline, in some characteristics, is superimposed. He argues that color is not a good taxonomic character and, given the range of variation in morphological characters throughout the range of Antilocapra americana, that subspecific designations are not justified and that mosaic patterns of color variability, coupled with clinal patterns in other features, make such subspecific designations meaningless (Cockrum 1981).

Despite Cockrum's arguments, the Sonoran pronghorn is presently a recognized subspecies of pronghorn. Hoffmeister (1986) describes the Sonoran pronghorn as a small-sized subspecies of A. americana in which the skull is narrow in mastoidal, orbital, and zygomatic width, rostrum is narrow, frontal depression not pronounced, and auditory bullae are small but variable. Hoffmeister also speculates that the type specimen of A. a. sonoriensis may be smaller than average for the subspecies.

HISTORIC DISTRIBUTION OF THE SONORAN PRONGHORN

Phelps and Webb (1981) acknowledge difficulties in mapping the historic distribution of the Sonoran pronghorn. The subspecies was not described until 1945, and specimens taken prior to that time were ascribed to other subspecies, and no specimens have been preserved from marginal, now extirpated, populations.

Nevertheless, based on Monson's 1968 work, they mapped the historic distribution of A. a. sonoriensis to include that portion of southern Arizona south of Phoenix, west of Tucson and south to Nogales, Santa Ana, and Hermosillo, Sonora, Mexico west to the Salton Sea in California, the Gulf of California in Sonora and northeastern Baja California (Phelps and Webb 1981).

PRESENT DISTRIBUTION OF THE SONORAN PRONGHORN

The present distribution of the Sonoran pronghorn is limited to an area south of the Gila River, east of the Gila and Tinajas Altas mountains, and south into Sonora Mexico to

about Caborca. Few recent observations of Sonoran pronghorn have been made east of Arizona Highway 85 between Gila Bend and Lukeville, nor have any been made east of this highway in Mexico (=Mexican Highway 2). The majority of recent observations have occurred in the Tule Desert, southern Mohawk Valley, and the San Cristobal and Growler valleys, roughly between the Cabeza Prieta Mountains on the west and the Agua Dulce, Ajo, and Crater mountains on the east (Figures 3 and 4).

The extant population of Sonoran pronghorn have been estimated at 300 to 450 individuals in Arizona and northwestern Sonora, Mexico (Phelps 1981a). Of this number, Phelps (1981a) estimated that approximately 100 to 150 animals would be found in Arizona, primarily on the Cabeza Prieta National Wildlife Refuge, Organ Pipe Cactus National Monument, and the Barry M. Goldwater Range. More recent estimates put the pronghorn population in Arizona at 85 to 90 individuals (AGFD 1985).

LIFE HISTORY OF THE SONORAN PRONGHORN

Food Habits

The habitat occupied by Sonoran pronghorn in southwestern Arizona and northern Mexico is open and sparsely vegetated desert. Observations on their diet have been recorded since 1908, with the first quantified food habits study conducted in 1974 through 1978 (Edwards and Ohmart 1981). Hornaday (1908) noted pronghorn eating an annual plantain (Plantago spp.) in the Pinacate Region. His are perhaps the first documented observations of Sonoran pronghorn food habits. Later, Lumholtz (1912) recorded pronghorn feeding upon the pendent fruits of jumping cholla (Opuntia fulgida), a behavior also noted by Monson (1968). Palo verde (Cercidium spp.), honey mesquite (Prosopis velutina), and ironwood (Olneya tesota) have been recorded as browse species by Monson (1968), but he concluded that pronghorn on the Cabeza Prieta National Wildlife Refuge (CPNWR) subsisted mainly on the dried and withered remains of annual and biennial plants, especially forbs. Carr (1970) compiled observations of pronghorn feeding over a two-year study period. These observations were limited to the spring period, and are therefore not representative of the pronghorn's diet. However, these observations do indicate several important food plants, such as cholla (Opuntia spp.), brittle brush (Encelia farinosa), bladderstem (Eriogonum inflatum), palo verde, and plantain.

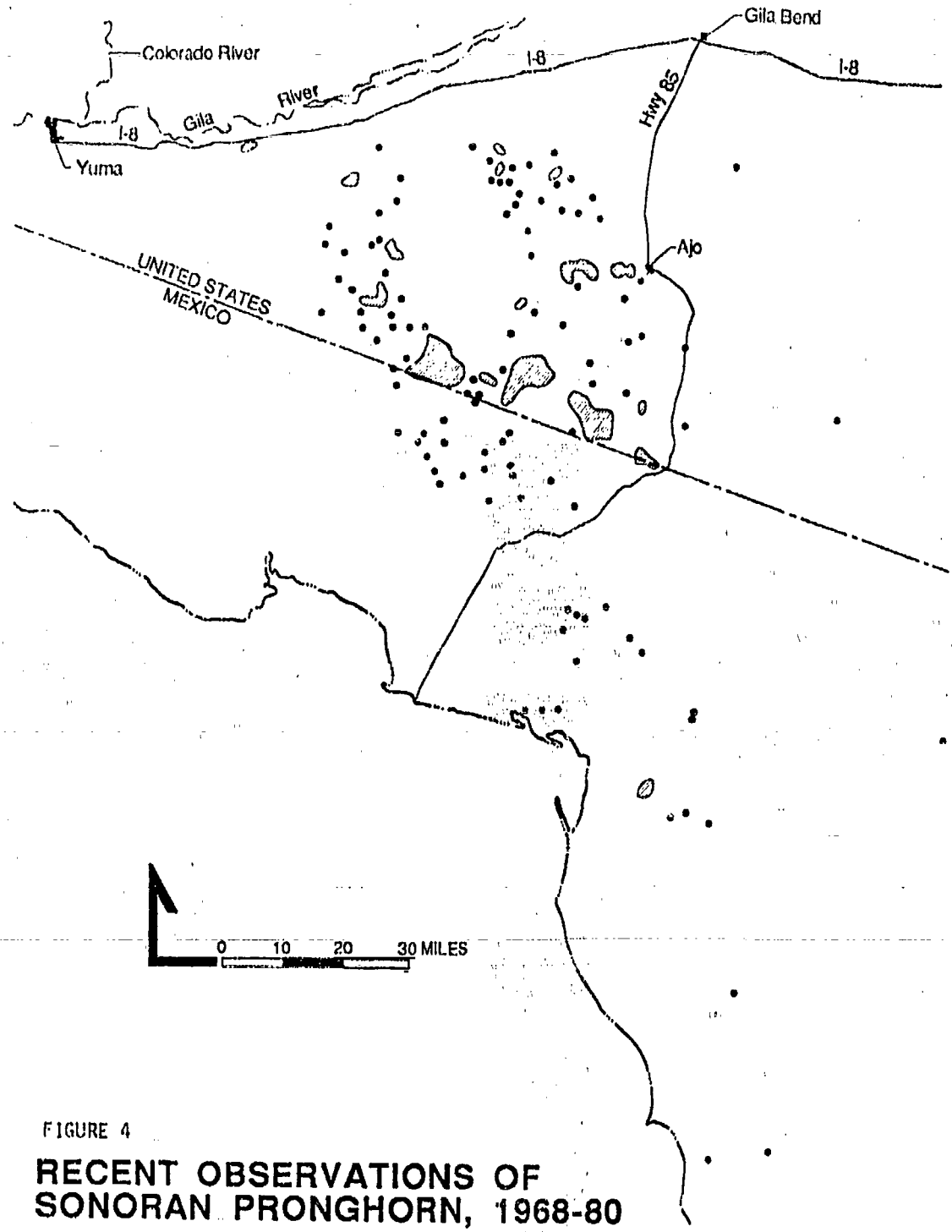


FIGURE 4

RECENT OBSERVATIONS OF SONORAN PRONGHORN, 1968-80

Edwards and Ohmart (1981) conducted the first quantified food habits study on the Sonoran pronghorn from 1974 through 1978. Food habits were determined by means of fecal analysis from pellets collected on the CPNWR. They determined that the diet of the Sonoran pronghorn, using all the fecal samples available, consisted of 69 percent forbs, 22 percent shrubs, 7 percent cacti, and 0.4 percent grasses.

Forbs appeared to be important in the spring and fall (September and October). Shrubs were more important in the winter (January), and pronghorn apparently did not select for grasses, which correlated well with the general observations found in other studies which suggested that pronghorn tended to be browsers (Edwards and Ohmart 1981).

Gaura and Camissonia, two genera in the evening primrose family (Onagraceae), and Dalea mollis, a member of the pea family (Leguminosae), were utilized in the greatest relative densities (Edwards and Ohmart 19). D. mollis is a mat-forming forb that grows on rocky soils and remains green for a relatively long period. Many different shrubs were also important throughout the year, and Opuntia spp. were important in the summer and winter. The fruits of the cholla were thought to provide food when little else was available in the driest months and probably supply some of the necessary moisture in the pronghorn's diet. However, forbs appear to be selected when they are available in late winter and early spring, and throughout the rest of the year when they are dried and withered.

Edwards and Ohmart (1981) felt that the ability of the Sonoran pronghorn to vary its diet with food availability enabled it to survive in the dry desert environment of southwestern Arizona and northern Mexico. Because of the harsh, arid environmental conditions of this region, Sonoran pronghorn are opportunistic and consume a variety of plant species when and if they are available.

Reproduction

Mating in American pronghorn (A. a. americana) usually occurs in late summer when bucks fight for harems of does. This probably occurs the first week of July in Sonoran pronghorn (Phelps 1981b). This mating season may last for only two to three weeks. The

gestation period is thought to be 240 to 252 days, with birth most often occurring during the first or second week of March in Sonoran pronghorn (Phelps 1981b; Yoakum 1980). American pronghorn does usually seek solitude during the parturition period, and usually have a single fawn at the first birth and twins thereafter (Yoakum 1980). The fawns remain inactive the first week of life as they grow and gain strength. However, they are able to outrun a man at the age of five days (Yoakum 1980). The fawns begin to eat vegetation within three weeks and acquire their adult-like pelage by three months. American pronghorn can mate at 16 months and breed throughout their life, which is 7 to 10 years (Yoakum 1980). Unfortunately, biological data concerning basic life history information on reproduction are not specifically known for the Sonoran pronghorn (USFWS 1982) to compare with the American pronghorn.

Mortality and Predation

Factors affecting the survival of American pronghorn have been studied extensively (Yoakum 1980). Natural predation by coyote (Canis latrans) and bobcat (Lynx rufus) have been documented on newborn fawns in Nevada and Alberta (Yoakum 1980), with as high as 50 percent of the annual fawn production succumbing. Coyote are the only documented natural predator of Sonoran pronghorn; however, other known predators of American pronghorn occur within their present range and known habitat (e.g., mountain lion, Felis concolor).

Several instances of mortality have been documented for Sonoran pronghorn (Phelps 1981b). Most have been man-related such as collisions with cars and illegal shooting. Disease as a mortality factor in Sonoran pronghorn populations is unknown, although well researched on the American pronghorn. A. a. americana is well known for its relative lack of epizootic diseases, and parasites are likewise uncommon (Yoakum 1980).

Behavior

Unlike the American pronghorn, the Sonoran pronghorn does not appear to congregate in large herds at any time of the year (Phelps 1981b). The mean herd size is usually less than four individuals. The largest herd observed between 1968 through 1980 consisted of

only 17 individuals. Phelps (1981b) felt that this difference in behavior between the two subspecies was a survival response to marginal habitat. Small groups are better able to insure the survival of the population during periods of high mortality.

Very little is known concerning the behavior of Sonoran pronghorn, compared to American pronghorn. The timing and length of movements, both daily and seasonal, home range size, and sociality and territoriality are well researched topics with A. a. americana (Yoakum 1980). Not so with A. a. sonoriensis. Basic biological data concerning reproduction, water requirements, food habits, and home range are lacking, and the Sonoran pronghorn's ecology is little understood. The Arizona Game and Fish Department (AGFD) has captured and radio-collared 19 Sonoran pronghorn on the Goldwater Range since 1983 (Dave Stanbrough, USFWS, personal communication, 2 December 1987) and monitored their movements in southwestern Arizona. Physiological parameters of the captured pronghorn were monitored, body measurements taken, and blood samples collected. Information on group size and composition, home ranges and movements, natality and mortality, behavior, habitat use, and food and water requirements is available from the early efforts of this work, but is extremely limited (AGFD 1985).

Habitat Utilization

From what is known, Sonoran pronghorn utilize different habitats at different times of the year. During the early spring (February through March), they can be found in sandy areas such as the Pinta Sands and Mohawk Dunes feeding on both annual and perennial vegetation produced from the winter rains (Phelps 1981b). These areas are sought out until the vegetation dessicates in May. The vegetation in these areas is extremely important as a source of quality forage with a high water content when the does are nursing fawns (Phelps 1981b).

During the hot summer months of May, June and July, Sonoran pronghorn can be found in the tree-lined desert washes feeding on what green vegetation they can find in the shade of trees and shrubs. Pronghorn are much more nomadic at this time of the year,

crepuscular in habit, and may cover large distances in a few days in search of forage (Phelps 1981b).

In the early fall, Sonoran pronghorn can be found on the bajadas or upper foot slopes of the desert mountains feeding on the new growth of annual and perennial vegetation produced from the summer storms of July, August and September. The forage is usually abundant here until November or December. Forage becomes scarce from December to February, and the pronghorn utilize the pendent fruits of jumping cholla to a large extent (Phelps 1981b).

Openness and visibility appear to be key habitat requirements for Sonoran pronghorn, and key factors determining habitat utilization. Also, the creosotebush-white bursage plant community, a major vegetation type within the Sonoran pronghorn's range, apparently is not frequently used. Creosotebushes are tall and restrict visibility, and provide little forage (Phelps 1981b). However, this plant community is utilized for travel corridors, escape routes, and daily ranging throughout the year (AGFD 1985).

Water Requirements

The water requirements of Sonoran pronghorn are not well known. Prior to 1987 there were no documented accounts of them drinking free water when it is readily available (Phelps 1981b). During the summer of 1987, a time-lapse camera recorded a solitary buck drinking. The animal appeared in only two frames, taken two minutes apart. Sonoran pronghorn have been observed near water sources, but never actually drinking before this event. American pronghorn can usually be found within three to four miles of water (Yoakum 1980). Rangelands that maintain high pronghorn numbers have water available every one to four miles. Carr (1973) felt that free water was a very important factor in the survival of Sonoran pronghorn in the desert. He based his opinion on a review of the literature and personal observations of Sonoran pronghorn seasonal movements. However, no studies have been conducted to determine water requirements for Sonoran pronghorn or if additional water development would enhance their chance for survival (Carr 1973). When succulent forage is available, American pronghorn require

one-quarter gallon of water per day. During dry summers, one gallon to a gallon and a half may be needed by these more northern members of the pronghorn family (Yoakum 1980).

Sonoran pronghorn radio-collared by the AGFD between 1983 and 1985 were relocated within 8 to 11 km of permanent or semi-permanent water sources, except during long range movements, throughout the year. Summer relocations placed all the collared pronghorn within 5 km of a federally maintained water source (AGFD 1985). They concluded that water development is apparently important to Sonoran pronghorn, and maintenance of those developments and others on the Range should continue.

HABITAT CHARACTERISTICS

The historic habitat of the Sonoran pronghorn included sizable portions of the Sonoran Desert. However, they are no longer distributed uniformly throughout. Available forage is probably the dominant factor influencing their distribution in this harsh, arid region of southwestern Arizona and northern Mexico. Extensive sandy areas, such as the Pinta Sands, Mohawk Dunes, and areas near the Gulf of California (Sea of Cortez), are sought out by Sonoran pronghorn for their combination of openness and great variety of palatable vegetation like small shrubs, grasses, and annuals (Carr 1981; Phelps 1981b). In addition to these sandy areas, Sonoran pronghorn utilize the wide alluvial valleys and playas in the region. Some of the playas extend over several square miles, and a few of them produce annual forbs after summer rains. The Pinta Playa is one such area (Carr 1981). Surrounding the sandy areas and playas typically utilized by pronghorn, the flats and plains are dominated by creosotebush (Larra tridentata) and bursage (Ambrosia dumosa). Nearer the mountains, the palo verde (Cercidium microphyllum)-cacti-mixed scrub community can be found.

Climate and Rainfall

Heat and aridity are characteristic of the Sonoran Desert and Sonoran pronghorn habitat. Summer temperatures often exceed 100°F in southwestern Arizona, with soil

temperatures reaching 160°F (Carr 1981). Normal temperatures during the cooler, winter months typically range between 65 to 75°F, and usually stay above freezing at night (Sellers and Hill 1974).

Sonoran pronghorn inhabit the driest region of Arizona. Annual precipitation averages only four inches for much of the area. Precipitation falls during two periods of the year. Half of the yearly rain falls during July, August and September. This precipitation is characterized by violent thunderstorms moving across southern Arizona from the Gulf of Mexico. The second period of rainfall occurs during the winter, with storms from the Pacific Ocean moving across southern California into Arizona (Sellers and Hill 1974).

Water

Free-standing water is almost nonexistent within the Sonoran pronghorn range in southwestern Arizona (Carr 1981). Only a few natural watering holes are available in the Sierra Pinta and the Tinajas Altas mountains. Quitobaquito Springs provides a permanent source of water, but because of its location and past human use, was probably never very important as a pronghorn watering area. Baker tanks between Baker Peaks and the Copper Mountains is the only other natural waterhole that would be readily available to pronghorn. This waterhole is unique because of its location on the valley floor rather than in the steep mountain canyons. However, the construction of a picnic area near the tank and frequent visitor use have probably decreased its attractiveness to pronghorn (AGFD 1985). This site is also on the periphery of presently known pronghorn distributions.

Carr (1981), assuming that Sonoran pronghorn require surface waters, felt that the Gila River and the Rio Sonoyta were probably the most important historic watering areas. Reports of pronghorn and other wildlife along the banks of the Gila River were common 100 years ago. The Rio Sonoyta in Mexico was a permanent, live stream 60 years ago before the community of Sonoyta was established along its banks. Today, the Gila River is normally dry and the Rio Sonoyta flows only intermittently (Carr 1981).

Vegetation

The present range of Sonoran pronghorn falls within two subdivisions of the Sonoran Desert (Turner and Brown 1982). The Lower Colorado River Valley subdivision, covering most of the region, is characterized by simple vegetative communities and a uniform appearance (Carr 1981). This subdivision is characterized by the creosotebush (Larra tridentata) - white bursage (Ambrosia dumosa) plant community. It commonly occurs in the valley floors and sandy plains between mountain ranges. Blue palo verde (Cercidium floridum), mesquite (Prosopis juliflora), and ironwood (Olneya tesota) can be found in the drainages where moisture availability is greater. Big galleta (Hilaria rigida) is common in stabilized sandy areas. Annual forbs and grasses are present in the spring with favorable moisture conditions.

The Arizona Upland subdivision, in contrast, is highly variable, much more complex, and dominated by small trees, shrubs and cacti. This subdivision includes some of the most famous and picturesque portions of the Sonoran Desert (Turner and Brown 1982). The dominant plant species are saguaro (Carnegiea gigantea) and foothill palo verde (Cercidium microphyllum). Mesquite and ironwood are common trees, with ocotillo (Fouquieria splendens), creosotebush and bursage also present. The variety of cacti found in this subdivision is noteworthy (Turner and Brown 1982). In addition to the dominant saguaro, organ-pipe cactus (Cereus thurberi) and senita cactus (Cereus schotti) can be found in southwestern Arizona within the pronghorn's range. Chollas (Opuntia spp.) are common in this subdivision, and the fruit of Opuntia fulgida has been documented as an important food item for Sonoran pronghorn (Carr 1981).

Some riparian vegetation can still be found along a few desert streams in the region. The Rio Sonoyta in Sonora, Mexico still supports some cottonwood (Populus fremontii) and willow (Salix spp.) along its banks, and seep willow (Baccaris glutinosa) and desert willow (Chilopsis linearis) can be found along other desert streams in the area (Carr 1981).

STATUS AND POPULATION TRENDS

The historical range and population size of the Sonoran pronghorn in southwestern Arizona and northern Mexico is unclear for several reasons. The subspecies was not

described until 1945 by Goldman (1945), with his description based on only two specimens (Carr 1972; Cockrum 1981). Disjunct populations of both Sonoran and Mexican subspecies occur in southern Arizona, but little material is available to taxonomists to determine the original subspecific distributions, so the subspecific status of extinct populations is not known (USFWS 1982). However, pronghorn were distributed throughout southern Arizona prior to 1900 (Davis 1973), and herds observed along the lower Gila River are thought to have been Sonoran pronghorn (USFWS 1982).

The first estimate of 105 pronghorn in southwestern Arizona was made by Nelson (1925) in 1924. Nichol (1941) estimated 60 pronghorn in southwestern Arizona in 1941, but excluded Organ Pipe Cactus National Monument in his estimate. McGuire (Carr 1970) also estimated 60 pronghorn in 1941. Less than 100 Sonoran pronghorn were estimated by Halloran (1957) in 1956. In 1963, 75 Sonoran pronghorn were estimated to be in the state (U.S. Department of the Interior (USDI) 1968), and in 1968 50 (Monson 1968). Between 1969 and 1970, Carr (1969, 1970) estimated between 50 to 150 Sonoran pronghorn in southwestern Arizona. Observations compiled throughout the 1970s have indicated a population of 50 to 150 as well (Phelps 1981a).

The Sonoran pronghorn population in Arizona and Sonora, Mexico was estimated to be between 300 to 450 individuals in 1981. Some movement occurs between Mexico and the United States, but no evidence exists for any large-scale seasonal movements or migrations (Phelps 1981b). Estimates for the segment of the population in Mexico have been 595 in 1924 (Nelson 1925), 1,000 in 1957 (Villa 1958), and 200 to 300 in 1981 (Phelps 1981b). Results of the AGFD study conducted between 1983 to 1985 indicated a population of 85 to 90 animals in Arizona (AGFD 1985).

Several reasons for the decline of the Sonoran pronghorn have been presented, and all have undoubtedly been factors at one time or another in the species decline. The primary factor has probably been the loss of habitat (USFWS 1982). Southwestern Arizona has changed significantly during the past 100 years with the loss of the Gila and Rio Sonoyta rivers as live streams (Carr 1973). Overgrazing has probably been a major factor, as well as unregulated hunting which still occurs in Mexico (USFWS 1982). Pressures on the population in Mexico can be expected to continue with the economic exploitation of habitat and poaching of pronghorn going unchecked.

EFFECTS OF LOW LEVEL AIRCRAFT ON PRONGHORN

Monitoring the effects of supersonic and low level military aircraft operations on wildlife is a relatively recent endeavor in the field of wildlife management. Scientists have studied the effects of noise on animals in the laboratory since the 1960s (Manci et al. 1987), but only recently has the focus of this research been directed at free-roaming species in wild populations. In an effort to compile and synthesize the available information in the literature, the USFWS, National Ecology Research Center, and the U.S. Air Force (USAF) created an information data base on the effects of aircraft noise and sonic booms on various animal species (Gladwin et al. 1987; Manci et al. 1987). This monumental effort was both timely and necessary for the USAF to aid in assessing potential military flight operations as required by the National Environmental Policy Act (NEPA) of 1969.

Not surprisingly, very little data are available in the literature concerning wildlife and aircraft noise. Most research in this field has been conducted on domestic farm animals or under laboratory conditions with domestic rodents, rabbits and birds (Manci et al. 1987). Unfortunately, the knowledge acquired from these laboratory experiments does not apply directly to wildlife on areas overflown by low level military aircraft (Manci et al. 1987). The data available from these studies provide insight into the behavioral and physiological effects of aircraft noise on animals, and can be utilized to plan and design future research with wildlife populations. But the need for controlled experiments with wild populations to answer the question of how low level aircraft operations effect wildlife is obvious.

Based on their literature review, Manci et al. (1987) suggest that wild ungulates, including pronghorn, are more sensitive to noise disturbances than domestic livestock. They felt that behavioral changes resulting from exposure to sudden or loud noise, such as sustained running or avoidance behavior, can cause increased expenditures of energy, which reduces the rate of survival and reproduction. This has been observed in the field with reindeer (Rangifer tarandus) and caribou (R. tarandus). To date, only one study concerning the reactions of pronghorn to aircraft appears in the published literature.

Luz and Smith (1976) recorded the reactions of pronghorn to helicopters in New Mexico. No reactions to the aircraft were observed at an altitude of 400 feet and a slant range from the herd of 3,000 feet. The pronghorn interrupted their grazing activity as the helicopter approached the herd at a descent rate of 200 feet/minute and a forward air speed of 40 to 50 knots. This was classified as a mild reaction. The herd began running when the helicopter was at 150 feet altitude and a slant range of 500 feet. This was classified as a strong reaction. They calculated the noise levels of no reaction and strong reaction to be approximately 60 and 77 dBA, respectively.

The effects of supersonic and low level military aircraft on wildlife, including wild ungulates, are now receiving some attention, especially in the western United States. The U.S. Navy and Nevada Department of Wildlife (NDW) initiated a joint study in 1985 at Naval Air Station Fallon to monitor the effects of military air operations on wildlife in Nevada (Lamp 1987). Pronghorn were not the primary focus of this ongoing research, but Rory Lamp (NDW, personal communication, 23 November 1987) believes pronghorn to be very sensitive to low level overflights. His results are preliminary and inconclusive at this time, but should provide much needed information in the near future, especially regarding the effects on desert bighorn sheep (Ovis canadensis) and mule deer (Odocoileus hemionus).

The USAF (Hill Air Force Base) and Utah State University (USU), in cooperation with the Utah Division of Wildlife Resources (UDWR), have also initiated a three-year study of the effects of low level and supersonic military aircraft on bighorn sheep, mule deer, elk (Cervus elaphus) and pronghorn (Grant Jantz, UDWR, personal communication, 23 November 1987). This research will address both behavioral and physiological effects from supersonic, subsonic, and low level aircraft, as well as helicopter operations on these species in western Utah (Gar Workman, USU, personal communication, 21 December 1987). This research may be the first to monitor and test the physiological as well as behavioral responses of wild pronghorn to low level aircraft.

In an extensive review of the literature on bighorn sheep ecology and low level military flight operations, Poley (1987) concluded that low level flights on the CPNWR will affect bighorn sheep, but the affect would be similar to the effects of bighorn sheep aerial surveys and less disruptive than capture operations. Therefore, the effects of possible random overflights were not considered significant to the bighorn sheep population on the refuge.

Concerning the sensitivity of pronghorn to supersonic and low level military aircraft, there appears to be a difference in opinion among professional wildlife biologists in the western United States. Bob Tully (Colorado Division of Wildlife, personal communication, 25 November 1987) believes that high speed, low level aircraft probably do not affect pronghorn in Colorado. The biggest potential danger from aircraft is frightening them into fences that they are unable to pass through (i.e., woven wire or chain link). However, he felt that helicopters have an entirely different effect on pronghorn, especially "nape of the earth training" (low level flight), and that their operations and effects warrant further study. Gar Workman (USU, personal communication, 21 December 1987) believes that helicopter pursuit and capture operations have no long-lasting behavioral effects on pronghorn in Utah, but the physiological effects, if any, are unknown and need further study.

Very few state wildlife agencies in the western United States are aware or concerned about the effects of low level military aircraft on pronghorn at this time. Rich Rothwell (Wyoming Game and Fish Department, personal communication, 23 November 1987) has observed pronghorn reacting to low level aircraft, but no research has been initiated in Wyoming to date. The USAF (Mountain Home Air Force Base) has included the Idaho Fish and Game Department (IFGD) on planning teams to route training flights away from areas used by bighorn sheep and pronghorn during the spring lambing and kidding season, but no research has been conducted in Idaho on the effects of low level aircraft (Ralph Pearson, IFGD, personal communication, 23 November 1987). The effects of low level aircraft on pronghorn do not appear to be an issue or concern in Nebraska (Carl Menzel, Nebraska Game and Parks Commission, personal communication, 24 November 1987), and no research has been conducted there or in Montana (Montana Department of Fish, Wildlife and Parks, personal communication, 23 November 1987), New Mexico (Marshal Conway, New Mexico Game and Fish Department, personal communication, 23 November 1987) or South Dakota (Ron Fowler, South Dakota Game, Fish and Parks Department, personal communication, 23 November 1987).

EFFECTS OF THE PROPOSED ACTION

Direct Effects

The probability of any Sonoran pronghorns being killed as a result of activities associated with the WTI Course appears to be exceedingly low. Live ordnance, if used as part of the training, will be confined to designated live-fire target areas within the Range. Use of these target areas over the last 40 years has not caused any known pronghorn mortalities. Apparently there is only a very slight possibility that individual animals could be killed or injured by live-fire events. In the absence of such events, however, it is difficult to envision additional scenarios in which pronghorns could be killed.

The probability of low level helicopter flights actually coming close enough to an individual pronghorn to elicit a flight response appears to be extremely low. This conclusion is based on the small Sonoran pronghorn population (an upper estimate of 90 individuals--AGFD 1985) present on the Goldwater Range, the size of the present U.S. range of the pronghorn (approximately 1,600 to 2,000 square miles, based on estimates generated from use areas reported by Carr (1981) and AGFD (1985)), and the low intensity of low level helicopter overflights that are scheduled (a total of six aircraft/day on five nonconsecutive days). Sonoran pronghorn are known to be dispersed over sizeable portions of their range and not to congregate in large groups (Carr 1981; AGFD 1985). In the spring months, pronghorn have shown a preference for upper bajada areas (AGFD 1985). While dispersion of the pronghorn will increase the chances of encounters with helicopters transiting their range, those events, if they occur at all, will involve few individuals.

Should direct overflights of some individuals take place, experience from pursuit and capture studies of Sonoran pronghorn suggests that serious or lasting detrimental effects are unlikely. These operations have involved 19 pronghorn with one fatality from a faulty net gun strike severing the animal's spine. The other events involved the deliberate close pursuit of the individual animal by helicopter to within a few tens of meters to allow capture with a hand aimed net gun. Following capture, the animals were fitted with radio telemetry collars and examined for various anatomical and physiological parameters before release. All of the collared animals apparently recovered quickly and fully from the experience. Some collared does had fawns during the telemetry period.

Obviously chance encounters with pronghorns by Marine Corps helicopters on straight-line transit flights at relatively high airspeeds would be many times shorter than those associated with the intentional pursuit and capture of the animals at much slower airspeeds and extremely close distances. As discussed earlier, observations of transitory helicopter flights near or over American pronghorns showed these overflights to result in only short fleeing responses from the animals.

The above argument is not intended to suggest that close, chance encounters of aircraft with pronghorns does not cause stress in the animal. Observations from pursuit/capture events do, however, indicate that apparently healthy adult animals can endure what must be a fairly intense stressful experience without outward signs of short- or long-term impairment. In contrast, infrequent, chance encounters with military aircraft can realistically be expected to induce significantly less stress and risk of impairment than pursuit and capture operations.

One important difference between the pursuit and capture events and low level military flights is that the WTI Course is conducted in the fall and spring and capture operations are scheduled for the fall only. Capture operations are not scheduled in the spring because Sonoran pronghorn fawn during this period and there would be an increased risk to pregnant doe and young fawns. Pregnant doe nearing fawning and fawns less than a week old are presumed to be more sensitive to disturbance than older fawns, non-pregnant doe, or bucks. The limited mobility of fawns in their first week of life could make them particularly vulnerable to predation or stress in the event that the doe was abnormally flushed from its vicinity by overflights. There are, however, a number of factors that must be considered when assessing these potentials.

First, assuming an upper population estimate of 90 Sonoran pronghorn and a buck to doe to fawn ratio of 55:100:42 (AGFD 1985) then 25 bucks, 46 doe, and 19 fawns could be expected as an average population breakdown. These figures reveal that a reduced portion of the total population would actually have the presumed heightened vulnerability to overflight disturbance.

Second, the intensity of low level flights scheduled is quite low in contrast to the expansiveness of the pronghorn range and the likely dispersion of flights on several flight tracks. As will be discussed in greater detail in the following mitigation section, the

U.S. Marine Corps has agreed to relocate several helicoper flight tracks and to eliminate another to protect potential pronghorn fawning areas. The chances of critically close overflights of Sonoran pronghorn with increased vulnerabilities will accordingly be very low.

Third, the fright-flight responses of American pronghorn to transitory aircraft has been observed to be of short distance and duration. The response of Sonoran pronghorn doe tending fawns may correspondingly be mild. This conclusion is speculative, however, and specific research would be necessary to clarify this probability.

Destruction or deterioration of Sonoran pronghorn habitat resulting from the proposed action should be minimal. Virtually all ground-based activities associated with the WTI Course will be located in the northwest sector of the Goldwater Range, well away from the major, known habitat areas occupied by Sonoran pronghorn (Figure 3). Moreover, the ground-based activity sites proposed to be used by WTI trainees have been used in similar missions in the past, and do not constitute examples of apparently preferred Sonoran pronghorn habitat. There will be no ground-based activities of any kind on the CPNWR, at Organ Pipe Cactus National Monument, or in any of the southern desert valleys along the U.S.-Mexico International Boundary where pronghorn appear to be most common. Consequently, it appears that primary habitat degradation and/or destruction will not be an effect of WTI training.

Indirect Effects

Indirect effects of WTI should similarly be minimal. Low level aircraft flights will have no effect on Sonoran pronghorn habitat, nor will they result in any increases or decreases in population numbers of any biota that prey on pronghorn or that are used by pronghorn. Dropping of live ordnance would have some effect on pronghorn habitat via local destruction of pronghorn forage species, but such use is restricted to designated target zones and no additional degradation of primary habitat would occur.

The cumulative effects of successive WTI Courses on Sonoran pronghorn are difficult to directly assess by virtue of an absence of data. Given that population estimates of the subspecies in Arizona have tended to range between 50 and 150 in the period of 1925 to

1982 (Phelps 1981; USFWS 1982) and WTI training began in 1977, there is no clear indication that WTI training has had a net negative effect on population numbers. Conversely, there are no indications that there has been no negative cumulative effect, although the latter seems intuitively unlikely and the net effect is probably close to neutral.

Summary of Effects

In summary, it seems that WTI training on the Barry M. Goldwater Range as outlined here will not have predictable and signifcant negative effects on populations of Sonoran pronghorn. The greatest danger appears to be the chance of a close encounter between low level (50 feet AGL) helicopters and pregnant female pronghorns, or doe with newborn fawns. Such encounters, however, appear to be statistically unlikely and would be of very short duration. Moreover, it is not possible to predict the levels of stress such encounters might cause in pregnant females, or any other pronghorn, due to a lack of informative data. Similarly, it is not possible to predict the specific number of pregnant females and/or newborn fawns that would likely be present during the spring WTI training period, but given the small total population of Sonoran pronghorn in Arizona, it seems reasonable to assume that fewer than 40 pregnant females and/or newborn fawns would be present. The greatest number of low level sorties passing over any point along proposed flight tracks is 12 per day (6 aircraft entering and exiting the range along the same flight track), and only 5 low level helicopter flight days are scheduled for the entire WTI course. Aircraft would be traveling at 60 to 90 knots at night and 100 to 130 knots during daylight. With such small numbers of sensitive pronghorn and aircraft, coupled with aircraft speed, close encounters are even less likely than when one considers the probability of encounters between aircraft and the entire pronghorn population.

The deployment of men and equipment on the range is restricted to an area of apparent, minimal pronghorn use (see Figure 3). Consequently, damage to pronghorn habitat and encounters with humans as a result of WTI training appear unlikely. Overflights by jet aircraft will occur at altitudes generally in excess of 200 feet, and are of such short duration that no impacts are expected.

It should be underscored that the above assumptions are speculative in the absence of a large body of hard data. Healthy animals have not shown any apparent, long-lasting stress effects from being pursued and captured for radio-collaring (Arizona Game and Fish 1985). We cannot, however, infer from this that pregnant females or newborn fawns or other stressed individuals could tolerate such disturbance. Consequently, caution is the proper path to follow and steps should be taken to minimize the likelihood of personnel and aircraft encounters with individual pronghorns and disruption of pronghorn habitat. Additionally, steps must be taken to increase the body of knowledge on the biology and habitat requirements of this species.

MITIGATION MEASURES AND ALTERNATIVES

Several measures to minimize the impacts of WTI training activities and operations on the small population of Sonoran pronghorn on the Barry M. Goldwater Range have been initiated by the USMC. At the request of the USFWS, several helicopter flight tracks were relocated and others were limited to spring use only or eliminated (Figure 2). The flight altitudes of both fixed wing and helicopter routes, as well as the timing of those operations, could not, however, be changed and still achieve the objectives of WTI training established by Headquarters Marine Corps. Fixed wing routes will probably have no adverse impacts on Sonoran pronghorn and no requests were made by the USFWS for alterations or relocations. Ground support unit locations are to the north and west of most recent pronghorn observations, heavily disturbed by previous vehicle traffic, and thought to be of little value as Sonoran pronghorn habitat. Therefore, continued ground activities at those sites will probably have no adverse impacts on pronghorn.

Helicopter flight tracks on the CPNWR near the Sierra Pinta, Bryan, Granite and Growler mountains were relocated two to three km away from the mountain bases and further into the valleys. The USFWS feels that relocating these specific flight tracks will minimize any potential conflicts with Sonoran pronghorn utilizing the bajadas along these desert mountain ranges. These relocations are indicated on Figure 2. Helicopter flight track H21 through the Growler Valley was eliminated, and flight track H20 was limited to spring WTI use only. These actions will minimize helicopter flight operation conflicts with Sonoran pronghorn in regions where the animals might be most sensitive to those activities.

In any chance encounters between Marine Corps air or ground units and the Sonoran pronghorn, the Marine Corps unit will continue its training exercise, and make no attempt to follow or harass the animals. In addition, the Marine Corps will provide data on the flight tracks actually used by rotary wing equipment over the Cabeza Prieta National Wildlife Refuge.

In addition to the above actions designed to minimize the impacts of WTI training operations on the Sonoran pronghorn, the USMC will direct $30,000 in 1988 to the USFWS for additional research on the Sonoran pronghorn. The USMC will strive to provide continued support and funding to provide for management and research on the Sonoran pronghorn and its habitat in the future. These funds are for research that will improve our understanding of the pronghorn's ecology, life history and habitat requirements, and provide opportunities for more effective management on the range. Research is currently underway in other regions of the western United States to quantify the behavioral and physiological effects of low level and supersonic military flight operations on pronghorn and other wildlife. Rather than duplicate those efforts, the USFWS may prefer to focus research on basic biological questions that will help clarify our knowledge of the Sonoran pronghorn and identify more effective management to facilitate the recovery and eventual delisting of this species.

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