

MOUNTAIN LIONS (Felis concolor) IN THE
VICINITY OF CARLSBAD CAVERNS AND GUADALUPE
MOUNTAINS NAT'L PARKS--AN ECOLOGICAL STUDY

March 6, 1986

by: Harvey and Stanley Associates, Inc.



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS

•

ENVIRONMENTAL PLANNERS

•

RESOURCE MANAGERS

**MOUNTAIN LIONS (*Felis concolor*)
IN THE VICINITY OF CARLSBAD CAVERNS
NATIONAL PARK, N. M. AND GUADALUPE
MOUNTAINS NATIONAL PARK, TX.**

AN ECOLOGICAL STUDY

FINAL REPORT

Prepared By

HARVEY AND STANLEY ASSOCIATES, INC.

Thomas E. Smith, M. A., Principal Investigator
Ronald R. Duke, M. A., Project Manager
Michael J. Kutilek, Ph.D., Project Advisor
H. Thomas Harvey, Ph.D., Principal in Charge

Prepared for

U. S. D. I., National Park Service
Contract # CX 702930017
Santa Fe, New Mexico

Attention Dr. Milford Fletcher
Mr. Barney Scharn

March 6, 1986

File No. 150-03

TABLE OF CONTENTS

	Page
I. Introduction	1
II. Study Area	2
III. Methods.....	7
Capture and Immobilization	7
Biotelemetry	8
Scrape Sites	9
Population Characteristics.....	9
Food Habits	11
Kill Analysis	11
Depredation	11
Scat Analysis	12
IV. Results	13
Capture and Immobilization	13
Biotelemetry	16
Home Range.....	16
Resident Males--Site Attachment and Overlap	41
Resident Females--Site Attachment and Overlap	44
Overlap of Adult Males with Adult Females	48
Family Groups	49
Dispersal	55
Movement	56
Relative to sheep predation.....	59
Relative to a kill	66
Activity	67
Mortality	68
Dead radio-collared lions	71
Lions whose fate is unknown	74
Reproduction.....	75
Natality	75
Female Reproductive Behaviour	76
Density	76
Scrape Sites	78
Food Habits	81
Kill Analysis	81
Scat Analysis	83
Depredations	87
V. Discussion.....	96
Home Range	96
Dispersal	98
Movement	99
Activity	101
Mortality	101
Natality	104
Density	104

TABLE OF CONTENTS

Food Habits	107
Kill Analysis	107
Scat Analysis	108
Depredations	109
Depredations and the National Parks.....	111
Management--Control and Protection	112
VI. Literature Cited	119
VII. Appendix A. Mountain Lion Radio Relocations.....	123

LIST OF TABLES

Table No.	Description	
1	Capture success between August 1982 and May 1984	13
2	Capture data for radio-collared mountain lions.....	14
3	Home range estimates of mountain lions.....	17
4	Distance moved by mountain lions between relocations.	57
5	Method of take for mountain lion mortalities.....	68
6	Cause of Death and method of take for collared lions.	71
7	Regional analysis of scrape site reuse.....	79
8	Topographical analysis of scrape site distribution...	81
9	Mountain lion prey data from kills discovered.....	82
10	Analysis of 318 mountain lion scat samples.....	84
11	Regional analysis of scat samples.....	85
12	Comparison of scat content between samples collected in association with scrapes vs those that were not..	86
13	Analysis of stomach and intestinal contents.....	87

LIST OF FIGURES

Figure No.	Description	
1	Study area	3
1A	Location of Ranches A, B, and C	6
1C	Time periods for radio-collared mountain lions	15
2	Home range, mountain lion M1.....	18
3	Home range, mountain lion M2	19
4	Home range, mountain lion M3	20
5	Home range, mountain lion M4	21
6	Home range, mountain lion M5	22
7	Home range, mountain lion M6.....	23
8	Home range, mountain lion M7	24
9	Home range, mountain lion M8	25
10	Home range, mountain lion M9	26
11	Home Range, mountain lion M10.....	27
12	Home Range, mountain lion M11.....	28
13	Home Range, mountain lion M12	29

Figure
No.

Description

14	Home Range, mountain lion F1	30
15	Home Range, mountain lion F2.....	31
16	Home Range, mountain lion F3	32
17	Home Range, mountain lion F4	33
18	Home Range, mountain lion F5	34
19	Home Range, mountain lion F6	35
20	Home Range, mountain lion F7.....	36
21	Home Range, mountain lion F8	37
22	Home Range, mountain lion F9.....	38
23	Home Range, mountain lion F10.....	39
24	Home Ranges, spatial distribution	40
24A	Known relationships	45
25	Home Range, with and without kittens, F4	50
26	Home Range, with and without kittens, F5	52
27	Home Range, with and without kittens, F9	54
28	Movement distances between daily relocations	58
29	Movements of F7 relative to sheep	61
30	Movements of M2 relative to sheep.....	62
31	Movements of M4 and M6 relative to sheep.....	64
32	Movements of M5 relative to sheep.....	65
33	Age and sex structure of lions killed	69
34	Locations of areas of high lion mortality.....	70
35	Location of 3 scat analysis regions of the study area.	80
36	Distribution of scats collected containing calf and sheep remains.....	88
37	Monthly distribution of reported sheep kills.....	89
38	Relation of lion presence to sheep losses	90

ACKNOWLEDGEMENTS

Special thanks are extended to houndsman and capture specialist Rocky McBride. His knowledge and ability were instrumental to the success of the study. The dedication of pilot Cliff Chetwin and field assistants Tracy Casselman and Gary Stolz is greatly appreciated. Dr. Milford Fletcher, and Jim Walters of the National Park Service also provided invaluable assistance. We gratefully acknowledge the initial efforts of houndsman Bill Butler. Thanks are also extended to Salty Hughes, Marion Hughes, Curtis Doyal, and David Kincaid, for providing valuable information. Nicky Smith, John Goodwin, Ron Porter, Ernie Jaquez, and Tom Sansom of the New Mexico Department of Game and Fish provided help and advice, and the Department in general cooperated wherever possible. Larry Henderson, Cydney Mahoney and Doug Buehler of the National Park Service provided valuable help and assistance. Harley Shaw of the Arizona Department of Fish and Game provided the use and companionship in the field of his hound, Lady. We are also thankful for the loan of a trailbike by Don Lappert. This work was funded by the National Park Service, to whom we are grateful.

ABSTRACT

MOUNTAIN LIONS (*Felis concolor*) IN THE VICINITY OF CARLSBAD CAVERNS NATIONAL PARK, N.M., AND GUADALUPE MOUNTAINS NATIONAL PARK, TX. Smith, T. E., R. R. Duke, M. J. Kutilek and H. T. Harvey; Harvey and Stanley Associates, Inc., Alviso, CA.

A three year study of mountain lions was conducted in the vicinity of Carlsbad Caverns National Park, New Mexico, and Guadalupe Mountains National Park, Texas in order to provide basic ecological information to the National Park Service. Accurate information was needed to enable the Park Service to refine and develop management plans in part because mountain lions were known to be killing sheep on ranches north of the boundaries of the two parks, and the role of mountain lions from these parks was not known. Twenty-two mountain lions were captured, fitted with radio-collars, released and monitored during the course of the study. The home ranges, movements, dispersal, activity, reproduction, and food habits of these animals were studied and reported. An estimated maximum of 58 lions (24 adult, 12 yearling, and 22 kittens) occupied the study area of 400 mi² (1036 km²) within the two parks and sections of the Lincoln National Forest at any one time. The average home range for adult males was 80 mi² (207 km²), and for females was 23 mi² (59 km²). In general, adult males traveled further than adult females, and females with 5-12 month old offspring travelled even less. Deer were the principal prey species for mountain lions, occurring in 82% of all scat (feces) collected. During the study period, 65 mountain lions (including 11 radio-collared animals) were killed on or near ranches bordering the National Parks. Some of these animals were adults from within the National Parks, some were young produced within the parks, and apparently others were from outside the study area. Six of the 11 radio-collared mountain lions which were killed were known or believed to have killed sheep, but whether the others did is unknown. Despite the large numbers of lions killed bordering park lands, no detectable changes occurred in mountain lion density during the study, which suggests that reproduction and immigration from other areas replaced the mountain lions which were killed.

INTRODUCTION

The history of many mountain lion populations in the western United States has been largely one of large scale persecution, yet remarkably, they are still present in most western mountain ranges coinhabited by deer (Anderson 1983). This generalization characterizes the past and present status of mountain lions in the Guadalupe Mountains of New Mexico and Texas. The ranchers of the Guadalupe Mountains area, in an effort to reduce sheep losses, have attempted to eradicate mountain lions from sheep pastures. Despite the deaths of many lions, sheep losses have continued.

This study was sponsored by the United States Department of the Interior, National Park Service. Its purpose was to gather basic data regarding the ecology of mountain lions in the Guadalupe Mountains of New Mexico and Texas. This information is intended to provide a better understanding of the mountain lion population dynamics within the Carlsbad Caverns and Guadalupe Mountains National Parks region. The need for this information arose in part from complaints by neighboring New Mexico sheep ranches of depredations by mountain lions believed to be coinhabiting Park lands and adjacent sheep range.

This is the final report of a 3 year study which began in 1982. A total of 22 mountain lions were radio-collared during the course of field work yet only 7 were believed alive at the conclusion of field efforts in June 1985. This heavy mortality made it difficult to gather extensive data regarding home range and movements, but it provided insights into the processes which influence both mortality and survival. These insights should be valuable in developing management programs for the National Parks and for adjacent lands as well.

STUDY AREA

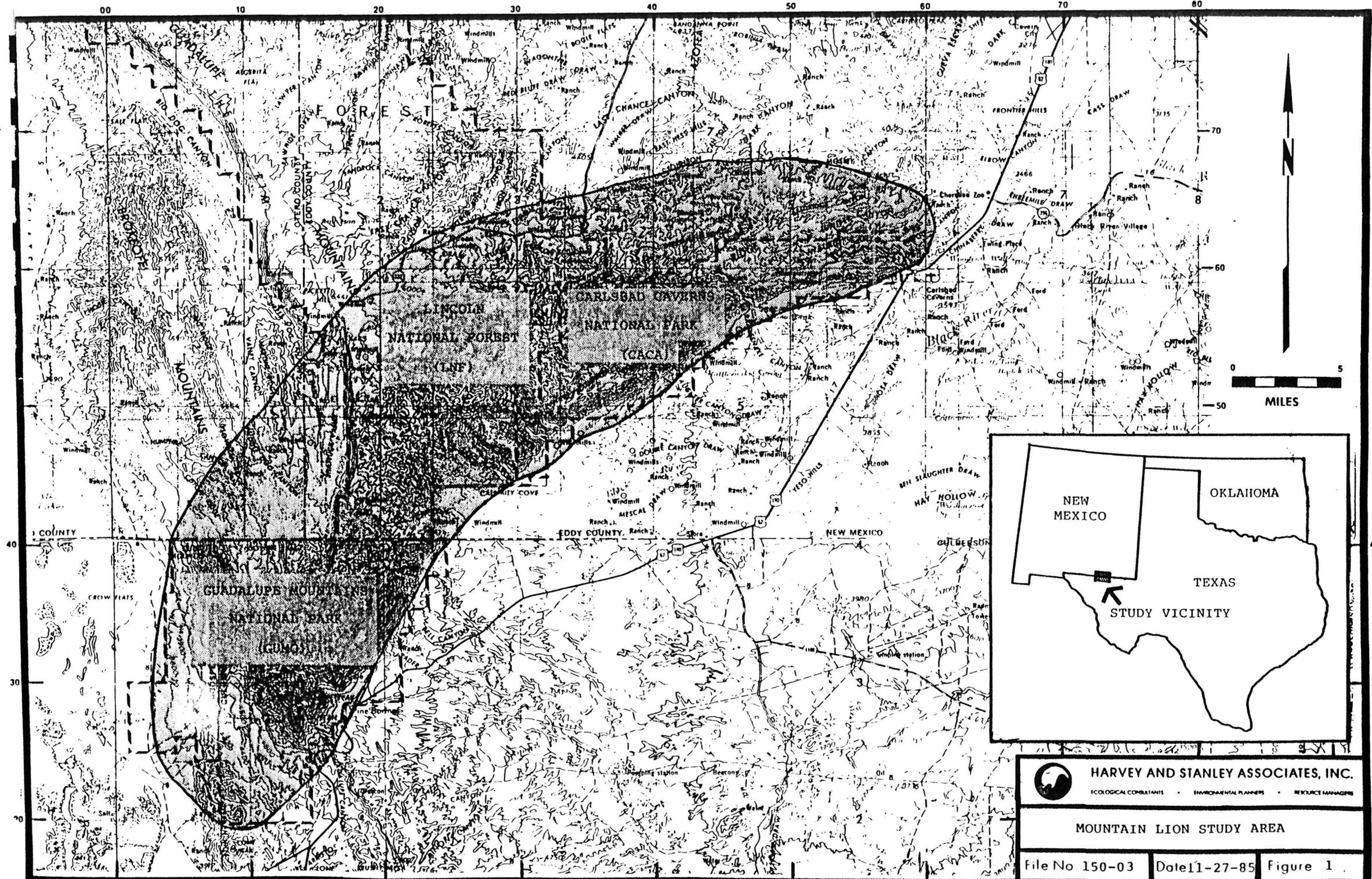
This study was conducted in a 1036 km² (400 mi²) area in the Guadalupe Mountains of Texas and New Mexico (Figure 1). The study area encompassed both public and private land 30 km (19 mi) southwest of Carlsbad, N.M. Approximately 90% of the study area is public land administered by the U. S. Department of the Interior (National Park Service and Bureau of Land Management), U. S. Department of Agriculture (National Forest Service), and the state of New Mexico. Three major regions were defined within the study area: Guadalupe Mountains National Park, Texas (GUMO) is the southernmost region, Carlsbad Caverns National Park, New Mexico (CACA) the eastern most area and the southern Lincoln National Forest (LNF) bordering both parks forms the central portion.

The elevations range from 1097 m (3510 ft) on the east side of CACA to 2667 m (8534 ft) at Guadalupe Peak in GUMO. Guadalupe Ridge is the major topographic feature influencing the shape and size of the study area. Its southeastern slope, or east escarpment, comprises approximately 50% of the study area and is dissected by numerous canyons cutting deeply into a paleozoic limestone reef. The northwestern slope, in contrast, is primarily a plateau ranging between 1524 m (4877 ft) and 1981 m (6339 ft) in elevation.

The primary watershed in the region is the upper 50 km (31 mi) of Dark Canyon. It drains the northwest side of Guadalupe Ridge but surface water is common only in a 2 km (1.2 mi) stretch of this canyon. Surface water is also found in deeper portions of canyons draining the east escarpment. Other water sources in the area include tinajas (natural rock basins), natural and developed springs, and stock ponds (tanks).

CLIMATE

Precipitation can occur within the study area at any month of the year but a greater percentage falls during the months of July,



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

MOUNTAIN LION STUDY AREA

File No 150-03 Date 11-27-85 Figure 1

August, September, and October. A less pronounced peak occurs during January, February, and March. The annual precipitation in CACA and GUMO is 35.5 cm and 53.5 cm, respectively (U.S.D.I. National Park Service Fire Management Data). The study area is essentially snowfree most of the winter but drifts up to 1 meter (3.2 ft.) deep and shallow accumulations are common in the higher drainages and north-facing slopes of GUMO.

Temperatures range from a mean daily minimum in January of 6.1° C (43° F) to a mean daily maximum of 33.7° C (93° F) in August at CACA. Extremes within GUMO range from a mean daily minimum of 11.1° C (52° F) in January to a mean daily maximum of 31.1° C (88° F) in July.

VEGETATION, FLORA AND FAUNA

The Guadalupe Mountains contain a mosaic of biotic communities. Vegetation at lower elevations within the study area is considered part of the Desert Scrub Community. The flora is represented by Larrea, Fouquiera and Agave. Genera characterizing the Madrean Evergreen Woodland Community, such as Quercus, Arbutus and Pinus, appear at higher elevations. Moderate stands of Pinus and Pseudotsuga occur at still higher elevations representing elements of the Paetran Montane Conifer Forest. Further descriptions of these communities are given by Brown (1982).

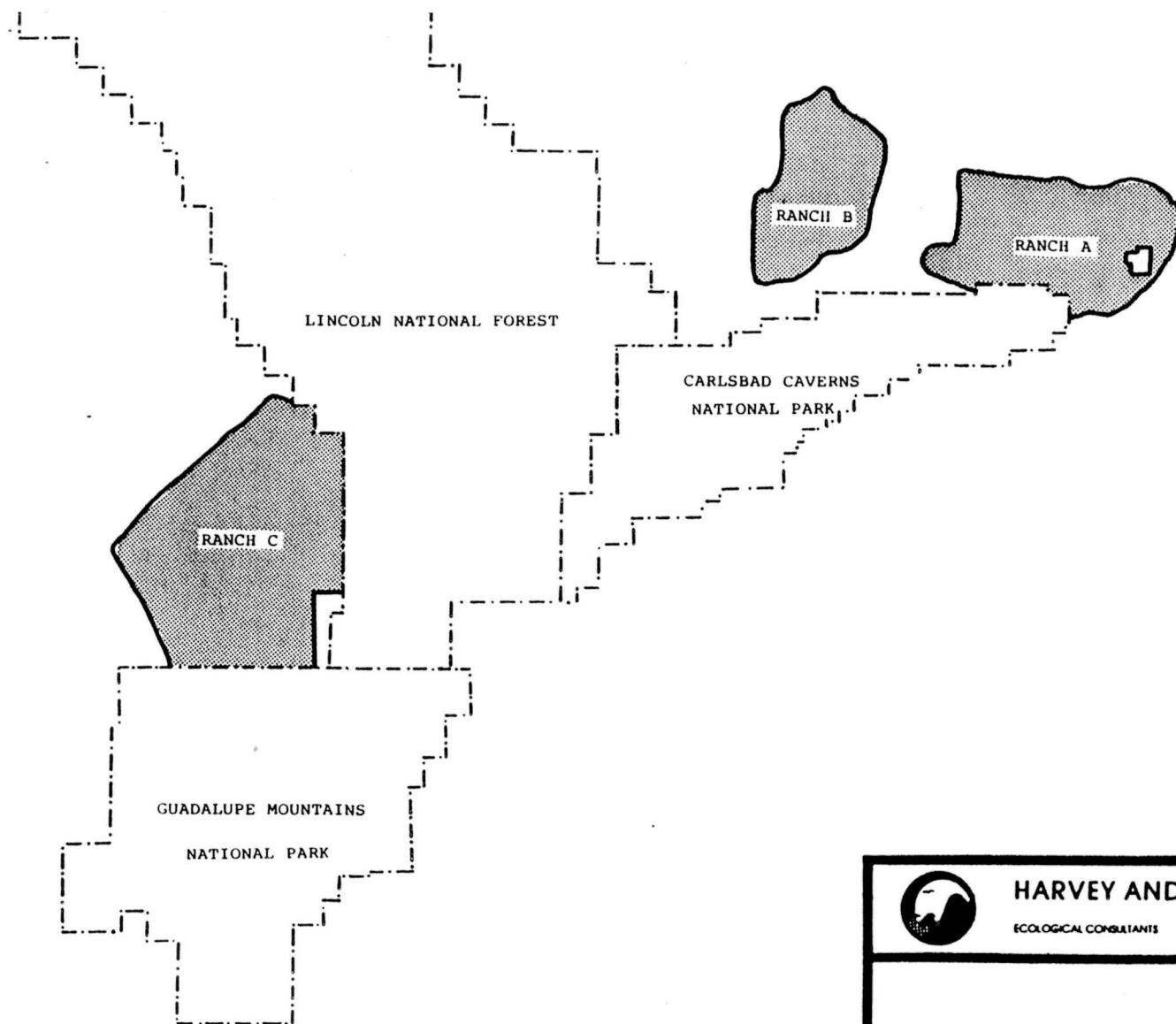
The fauna within the study area includes several species of large native herbivores. Mule deer (Odocoileus hemionus), is the most abundant of these and is distributed throughout the study area. Elk (Cervus elaphas) occur in small numbers, primarily in GUMO, and are infrequently seen along portions of the Guadalupe Ridge. An introduced herbivore, the aoudad (Ammotragus lervia) is found in low numbers in rugged parts of the east escarpment.

There are other animals inhabiting the study area which might serve as prey for mountain lions, including the porcupine (Erethizon dorsatum), black-tailed hare (Lepus californicus), cottontail (Sylvilagus audubonii), rock squirrel (Spermophilus

variegatus) and turkey (Meleagris gallopavo). Smaller mammals inhabiting the region are described by Genoways et al. (1979).

The largest carnivore in the area is the black bear (Ursus americanus). Bear sign is seen commonly in the high forested drainages of GUMO but is encountered infrequently in LNF, and rarely in CACA. Smaller carnivores include the bobcat (Lynx rufus), coyote (Canis latrans), gray fox (Urocyon cinereoargenteus), raccoon (Procyon lotor), ringtail (Bassariscus astutus), and hog-nosed skunk (Conepatus mesoleucus). Additional carnivores common in the area are described by Genoways et al. (1979) and Schmidly (1977).

Ranching is the major economic activity in the study area. Sheep (Ovis aries) and cattle (Bos taurus) are grazed on lands north of both GUMO and CACA. Cattle are grazed over most non-park property. For a number of years, sheep ranchers on three ranches, designated A, B, and C (Figure 1A), have lost sheep to depredating lions.



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

File No.

Date

Figure

METHODS

CAPTURE AND IMMOBILIZATION

The study began in July 1982 with preliminary field investigations to discover areas used by mountain lions and to gain familiarity with the region. Capture efforts were initiated in August 1982 with houndsman Bill Butler, using the method of Hopkins and Kutilek (1979). Trained hounds were used to track and bay mountain lions. A vehicle or trailbike was driven slowly while the driver looked for tracks in the LNF, where dirt road systems were adequate. Capture efforts were suspended in September 1982, when Mr. Butler returned to California.

Capture efforts resumed in December 1982 with a local houndsman, Rocky McBride. Methods were similar to those of Hornocker (1970) but with dry land modifications as described by McBride (1976). A maximum of five hounds was worked on foot or horseback. Intensive efforts were made on successive days in areas where relatively fresh sign was consistently noted.

Once the animal was treed or bayed an immobilizing drug was administered through a syringe fired from a CO₂ or powder charge rifle. A 1.00:0.14 mixture of ketmaine hydrochloride (Vetalar, Ketaset) and xylazine hydrochloride (Rompun) (Clark et al. 1979) was used on 21 restraints. An additional capture was with a 1.00:0.10 Ketamine/Sparine preparation. Dosages ranged from 2cc for individuals with estimated weights approximating 23 kg (51 lb) to 5 cc on adult males with estimated weights exceeding 55 kg (120 lb). Dental characteristics were noted to determine age using criteria established by Ashman and Greer (1976). Sex and reproductive condition were also noted. Pad widths of the front and hind feet were measured. Spring scale weights were obtained when possible and estimated weights made when conditions did not permit use of a scale. A radio-collar was affixed to the lion's neck. Immature (i.e. growing) lions were either radio-collared and recaptured at a later date (to enlarge the collar) or ear tattooed and released. A single kitten (#03), littermate of M2 was ear-tattooed and not radio-collared.

BIOTELEMETRY

The telemetry equipment that was used was manufactured by Telonics, Inc. of Mesa, Arizona and operated on frequencies ranging from 148 to 151 MHz. Locations of lions were obtained on radio-collared animals by using ground and aerial monitoring. Ground monitoring was conducted on foot, horseback, trailbike, truck and car. Aerial monitoring was conducted two to four times per month from fixed wing aircraft by study personnel from January 1983 through June 1985. The New Mexico Department of Game and Fish provided occasional aerial relocations as well. Ground monitoring provided information regarding activity and short term movements, while aerial monitoring provided information on spatial relationships at a single point in time and on long term movements.

Activity during nocturnal tracking efforts was determined by slight variations in signal strength (Seidensticker et al. 1973) for most radio-collared lions. Diurnal activity was recorded for 2 mountain lions through the use of radio-collars equipped with a 5 minute delay between fast (active) and slow (inactive) signal modes.

Relocations of radio-collared lions were recorded to the nearest hectare (2.5 ac) using UTM (Universal Transverse Mercator) coordinates. The quality of each relocation was determined subjectively using characteristics of signal reception. Relocations were classified as type 1, 2, or 3, depending on whether the lion could be placed within a circle 0.5 km (0.3 mi), 0.5 to 1.5 km (0.3 to 0.9 mi), or greater than 1.5 km (0.9 mi) in diameter, respectively (Hempker 1982). Only type 1 and 2 locations were used in delineating home ranges and calculating movements. The dispersal distance was calculated from the center of activity (Hayne 1949) of the appropriate home range(s). Movements were calculated by measuring the distance between daily relocations 1-10 days apart. All movement distances are in airline kilometers or miles unless otherwise stated.

The home range polygons were constructed for this report by connecting the outermost locations as described by Mohr (1947). Many radio-collared lions were killed by predator control efforts as the study progressed. As a result, many of the radio-collared lions died before a substantial number of relocations was obtained, and the range of movements observed was probably an underestimate of their true home ranges. Connecting the outermost locations was the best possible estimate of the true home range of a given lion under these circumstances.

SCRAPE SITES

Mountain lion scrapes or scratches are marks made primarily by male mountain lions. They provide visual signals for olfactory information, important for intraspecific communication (Seidensticker et al. 1973). Some scrapes are revisited periodically by resident lions (Ashman 1978, McBride 1976, Seidensticker et al. 1973, Smith 1981). Location, number of scrapes, substrate, topographic setting, and date found were recorded for each scrape site encountered in the course of field work. Many sites were reinspected at various intervals during the year to note reuse. The monitoring of reused (or active) sites has been considered by Ashman (1978) as a possible means of monitoring population trends. The topographic and regional distribution of scrape sites is described in order to assess the potential of using scrape sites in long term monitoring programs. The cataloging of reused scrape sites was intended to yield insights into identifying regions and habitats potentially important to intraspecific communication of resident adults and transients.

POPULATION DENSITY AND CHARACTERISTICS

Records were kept on mountain lion mortalities from sport hunting and lion control activities outside park boundaries. Age, sex, date, and location data were gathered on as many mortalities as possible. Attempts were made to inspect the skull, dentition, and hide, and to retrieve the carcass for necropsy. When inspection of a mountain lion mortality was not possible the

hunter, trapper, or rancher was asked about general characters of the mountain lion (i.e. sex, actual or estimated weight, presence or absence of spotting, and canine tooth eruption. Since virtually all known mountain lion mortalities occurred within New Mexico, records were compared with those of the New Mexico Department of Game and Fish. The general locations of all mortalities occurring during the 36 month study period were recorded. Areas where lion mortalities appeared to be clumped were mapped.

Age categories for mountain lions used in this study are: kittens, birth to 6 months; juveniles, 7 to 18 months; subadult, 19-24 months; mature adults 2 - 8 years; old adult, over 8 years (Hopkins 1985). The term "yearling" is used to identify mountain lions between 12 and 24 months of age which could not be aged more accurately. This term also best describes the general ages of dispersing lions seen in this study. Consequently, the term yearling includes older juveniles and subadults.

Sets of tracks were recorded using the method described by Harvey and Stanley Assoc., Inc. (1980) and Kutilek et al. (1983) as an aid in determining the presence and general size class of lions. The tracks were identified as "kitten" when the width of the rear pad was less than 41 mm (1.6 in); yearling, young adult, or adult female when 41-51 mm (1.6-2.0 in); and adult male if over 51 mm (2.0 in). Measurements for these categories were derived from Shaw (1979), Donaldson (1975), and lions of known age and sex from within the study area.

Maximum density was estimated for "yearling" and adult lions from the maximum number of adults or yearlings detected for a two month period for a 259 km² (100 mi²) area. This value was then extrapolated to the entire study area. An estimate of the number of kittens in the population is made based in part on the number of adult females in the maximum population estimate, and in part on fecundity (Anderson 1983) and kitten survival data (Hempker et al. 1984).

FOOD HABITS

Kill Analysis

Mountain lions frequently prey on animals too large to consume in a single meal. Ungulates killed by mountain lions were recorded as they were encountered during field activities. They were usually found either by following lions with hounds during capture efforts, or by following radio-collared individuals with radiotelemetry, and noticing that a lion was staying in one general location. Carcasses which were uncovered by these methods were considered lion kills only if there was conclusive evidence of lion predation such as tooth marks, subcutaneous hemorrhaging, lion sign, or characteristic carcass deposition (drag marks and/or covering of the carcass with debris) (Shaw 1979, Wade and Bowns 1982). Prey species, age, sex, and a visual estimate of marrow fat content were recorded for each kill. The lower jaw was collected to determine age by tooth replacement and wear (Quimby and Gabb 1957, Robinette et al. 1957). A qualitative measure of marrow fat color and consistency was recorded (Cheatum 1949).

The general characteristics of the lion killed sample were assessed as were movements and interactions relative to ungulate kills. The impact of mountain lion predation on the deer population was beyond the scope of this study.

Depredation

Knowledge of livestock loss attributed to mountain lions was dependent upon information received from ranchers. Information was requested regarding species, date of loss, location, extent of feeding, and presence of lion sign. Verification of kills were usually made by state and federal predator control personnel, yet many unverified reports of losses were received days, weeks, and sometimes months after they occurred, precluding verification. Dead sheep were often found weeks after they were killed. Consequently, reported depredations reflect the long-term pattern and extent of losses, but do not necessarily

indicate the specific times of the kills. Movement patterns of depredating mountain lions relative to sheep pastures were also assessed.

Scat analysis

Mountain lion scats were collected whenever encountered during the course of field work. Scats were identified by characteristic form as determined from known samples and Murie (1954). Scats of small diameter were not collected. Scats with a maximum diameter of less than 25 mm which did not have additional evidence of their origin were discarded from final tabulations. This would result in elimination of approximately 30% of potential lion scats as determined by Smith (1981) from a sample of scrape-associated lion scats, while potentially including only 8 - 9% coyote scats as determined from a sample of known coyote scats (Danner and Dodd 1982).

Scats were washed over 1 mm (0.04 in) mesh screen trays and air or oven dried. Hair and bone material were identified by comparison with specimens of known taxa collected from the study area. Hair was identified microscopically under low power magnification using reference slides and photomicrographs from Moore et al. (1974). Food items were recorded by frequency of occurrence. Where possible, deer bone fragments and hair found in scat were categorized by age; mature (greater than 12 months) and fawn (0-12 months). Remains without age evidence were classified as mature deer, which underestimates the fawn frequency to an unknown degree.

RESULTS

CAPTURE AND IMMOBILIZATION

Twenty two mountain lions were radio-collared during 143 days of capture effort between August 1982 and November 1984 (Table 1). The collared animals include 7 adult males, 7 adult females, 2 juvenile males, 1 subadult female, 3 male kittens and 2 female kittens (Table 2). Figure 1B illustrates the periods during which these mountain lions were monitored, and periods prior to their capture when individual lions may have been in the study area (based on their approximate age at capture).

Table 1. Capture success between August 1982 and November 1984.

Capture period	No. of hunting days	No. of lions bayed or treed	No. of lions radio-collared	No. of recaptures
Aug.-Sept. 1982	22	1	1	-
Dec.-Feb. 1982-83	21	9	4	2
May-Aug. 1983	47	8	7	1
Apr.-May 1984	27	7	5	2
Oct.-Nov. 1984	26	8	5	3
Totals	143	33	22	8*

*Four recaptures of radio-collared lions were conducted with the aid of functional transmitters. Juveniles recaptured for radio-collar adjustment are not included in the table.

Table 2. Capture data on 22 radio-collared mountain lions in the Guadalupe Mountains of Texas and New Mexico, 1982-1984.

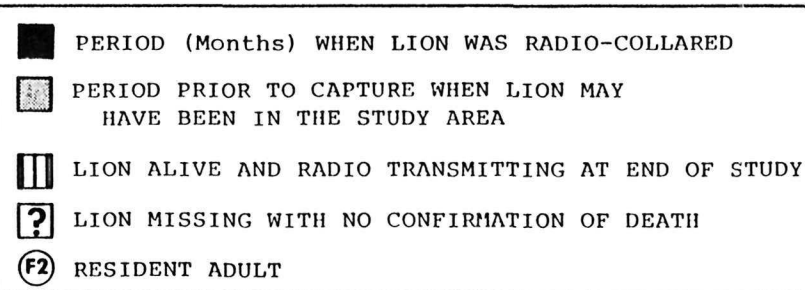
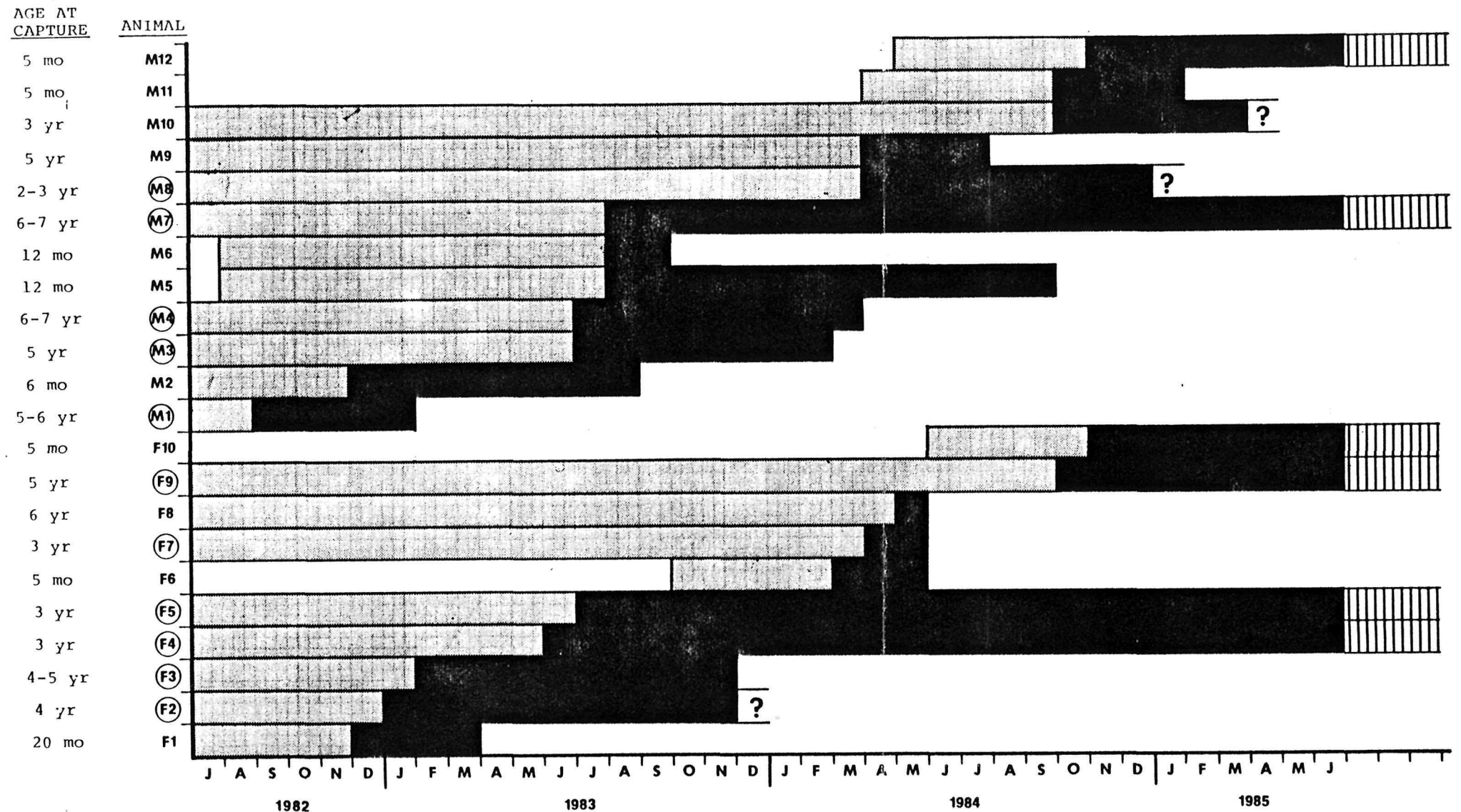
ID Code ¹	Date of Capture	Loc. of Capture ²	Weight Kg. (lbs)	Approximate Age ³
M1	09-02-82	LNF	63 (140)	5-6 yrs.
M2	12-23-82	GUMO	24 (53)	6 mos.
M3	07-01-83	GUMO	57*(125)	5 yrs.
M4	07-14-83	GUMO	61*(135)	6-7 yrs.
M5	08-08-83	CACA	29* (65)	12 mos.
M6	08-08-83	CACA	29* (65)	12 mos.
M7	08-11-83	LNF	59*(130)	6-7 yrs.
M8	04-10-84	CACA	55*(120)	2-3 yrs.
M9	04-16-84	LNFV	59*(130)	5 yrs.
M10	10-05-84	GUMOV	39 (86)	3 yrs.
M11	10-22-84	CACA	19 (42)	5 mos.
M12	11-11-84	LNF	19 (43)	5 mos.
F1	12-21-82	GUMO	24 (53)	20 mos.
F2	01-16-83	CACA	30* (65)	4 yrs.
F3	02-07-83	CACA	35 (77)	4-5 yrs.
F4	06-22-83	LNF	29 (64)	3 yrs.
F5	06-29-83	GUMO	32* (70)	3 yrs.
F6	03-29-84	GUMO	20 (43)	5 mos.
F7	04-13-84	GUMO	37 (81)	3 yrs.
F8	05-20-84	LNF	36* (80)	6 yrs.
F9	10-30-84	CACA	34 (75)	5 yrs.
F10	11-16-84	LNF	15 (34)	5 mos.

¹ M= male, F = female

²GUMO= Guadalupe Mountains National Park, Texas: LNF= Lincoln National Forest, New Mexico: CACA= Carlsbad Caverns National Park, New Mexico: V= Vicinity.

* Estimated weight

³ Ages here are best approximation based on field examination. Estimation of adult lions may vary 1 or more years from approximation listed here. There are no known methods of reliably aging lions in the field.



HARVEY AND STANLEY ASSOCIATES, INC.
 ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS
 TIME PERIODS (TEMPORAL DISTRIBUTION)
 FOR RADIO-COLLARED MOUNTAIN LIONS
 File No 150-03 Date 11/27/85 Figure 1B

BIOTELEMETRY

Sixty two monitoring flights were made from November 1982 through June 1985. Relocation success per flight for individual lions with functional collars was highly variable, ranging from 23% for M3 to 82% for F5. Ground monitoring success was influenced primarily by the affect of rugged terrain on access, mobility, and signal reception and secondarily by the size of the lion's home range. As a result, the number of relocations achieved for each lion varied greatly. The high mortality rate has also been a serious factor affecting data collection during the study. Seven mountain lions (F1, F6, F7, F8, M6, M9 and M11) lived an average of only 55 days (range = 12-96 days) between capture and death (Figure 1B).

HOME RANGE

Six-hundred and sixteen type 1 and 2 relocations (see methods page 8) of radio-collared mountain lions were recorded (Appendix A). Type 1 locations comprised 37 percent of the relocations. Figures 2-23 illustrate the total home range for each radio-collared mountain lion monitored during this study. The size of the home range for each lion is summarized in Table 3.

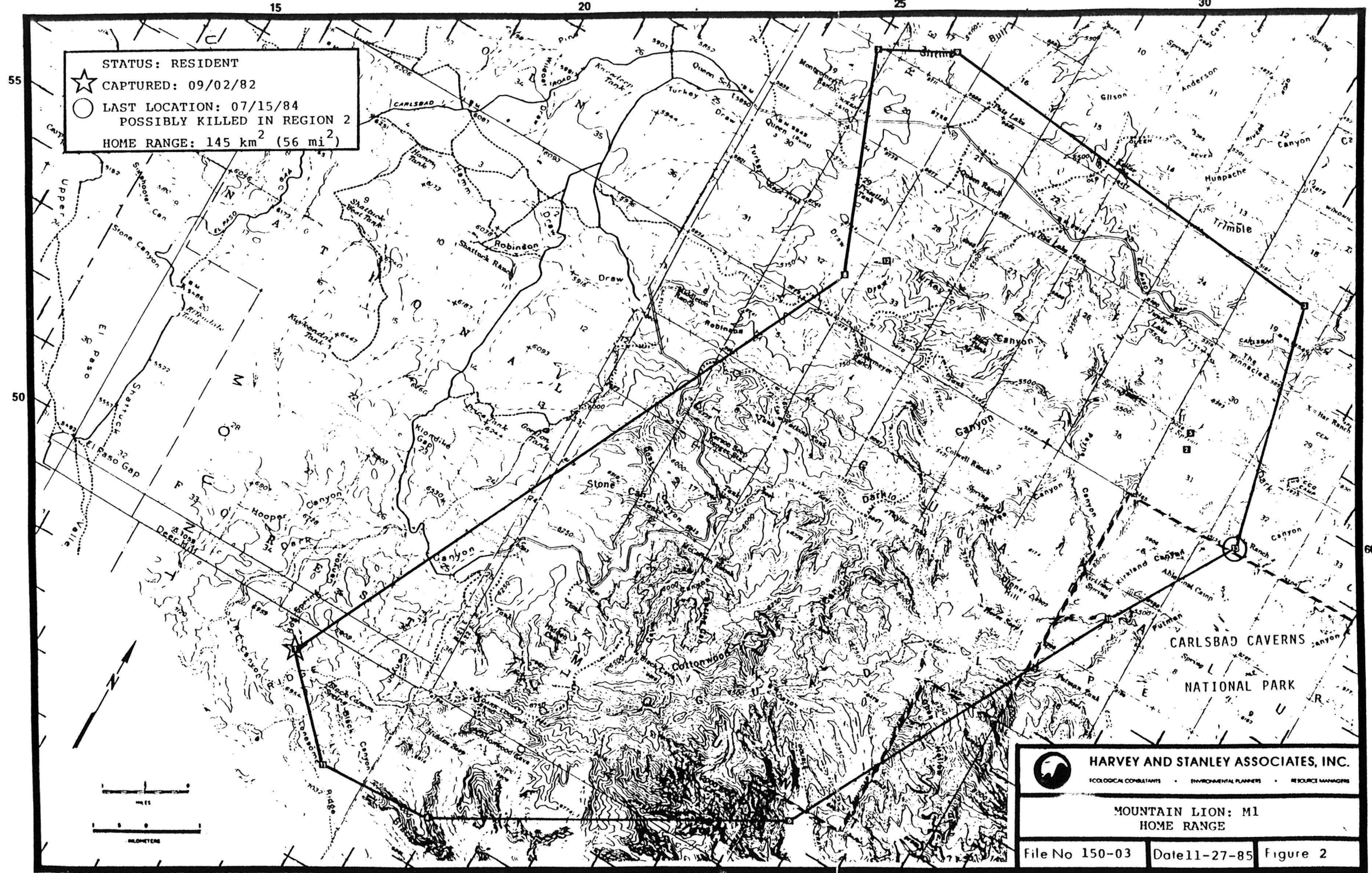
The average home range size for adult males in the study area was 207 km² (80 mi²). This is based on the home ranges of M1, M4, M7 and M8, considered representative based on comparatively large numbers of relocations over a period of at least several months. The average home range size for adult females was 59 km² (23 mi²), based on the home ranges of F3, F4, F5 and F9 (using the criteria noted above for males).

Table 3. Home range estimates of mountain lions in the Guadalupe Mountains (September 1982 through June 1985).

Mountain lion	Capture Date	Last Location	No. of Locations ¹	Home Range		Population Status ²
				km ²	mi ²	
M1	09-02-82	07-15-84	13	145	56	R
M2	12-23-82	08-13-83	25	18	7	J,D
M3	07-01-83	02-23-84	12	91	35	R
M4	07-14-83	03-16-84	35	236	91	R
M5	08-08-83	09-12-84	31	171	66	J,SA,R
M6	08-08-83	09-20-83	9	--	--	J,D
M7	08-11-83	06-29-85	43	277	107	R
M8	04-10-84	12-26-84	27	171	66	R
M9	04-16-84	07-18-84	7	44	17	U
M10	10-05-84	03-08-85	9	516	196	T
M11	10-21-84	01-03-85	30	34	13	K,J
M12	11-11-84	06-29-85	37	52	20	K,J
F1	12-21-82	03-27-83	12	10	4	SA,U
F2	01-16-83	07-14-83	9	10	4	R
F3	02-07-83	11-28-83	23	39	15	R
F4	06-22-83	06-19-85	72	98	38	R
F5	06-29-83	06-29-85	67	60	23	R
F6	03-29-84	05-16-84	24	16	6	K,J
F7	04-13-84	05-13-84	17	16	6	R
F8	05-20-84	06-01-84	3	--	--	U
F9	10-30-84	06-29-85	83	39	15	R
F10	11-16-84	06-29-85	28	54	21	K,J

¹Numbers given are for type 1 and 2 locations only.

²D=Dispersing, J=Juvenile, K=Kitten, R=Resident adult, SA=Subadult, T=Transient, U=Unknown status.



STATUS: RESIDENT
★ CAPTURED: 09/02/82
○ LAST LOCATION: 07/15/84
POSSIBLY KILLED IN REGION 2
HOME RANGE: 145 km² (56 mi²)



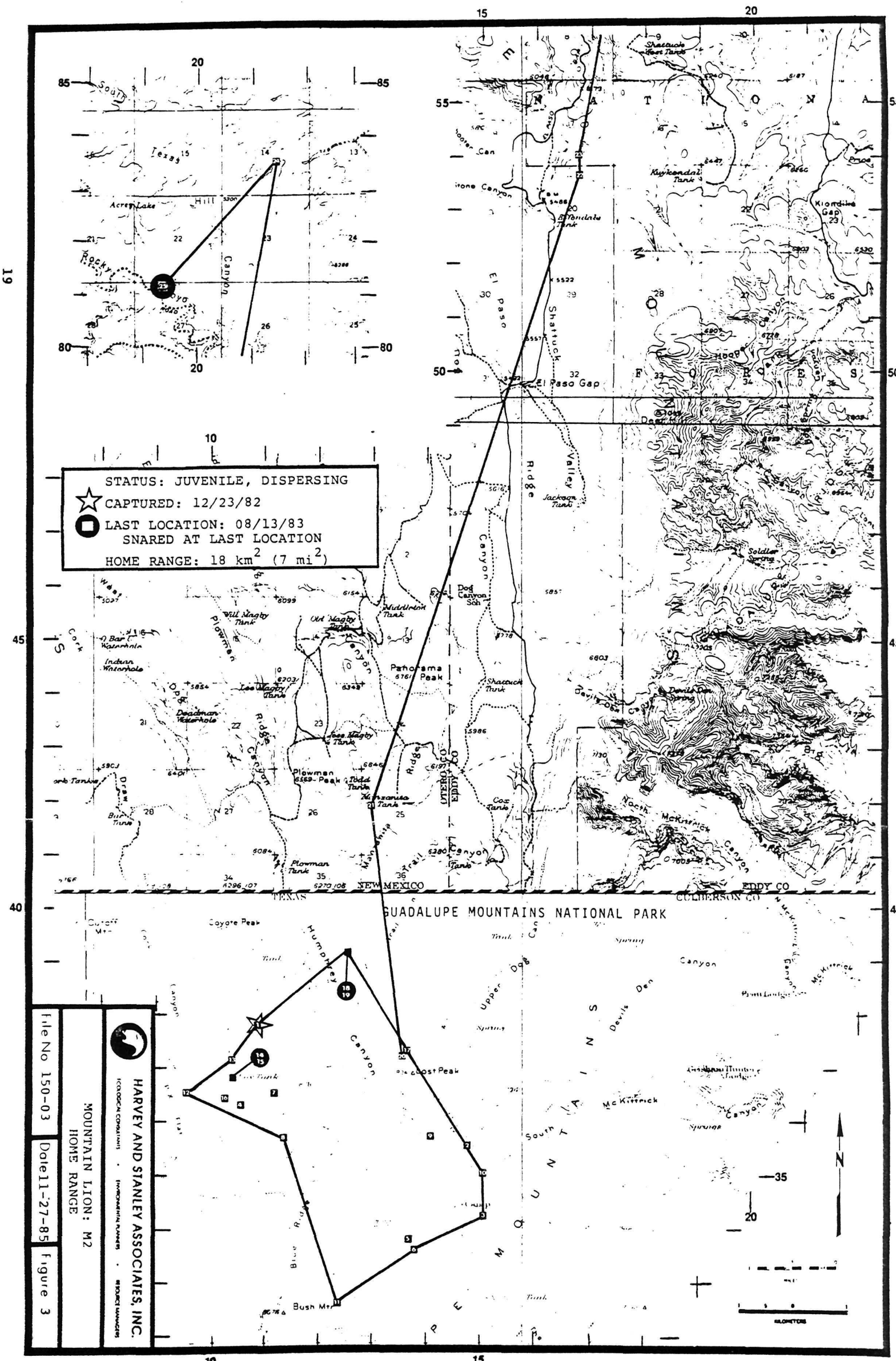
HARVEY AND STANLEY ASSOCIATES, INC.
ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

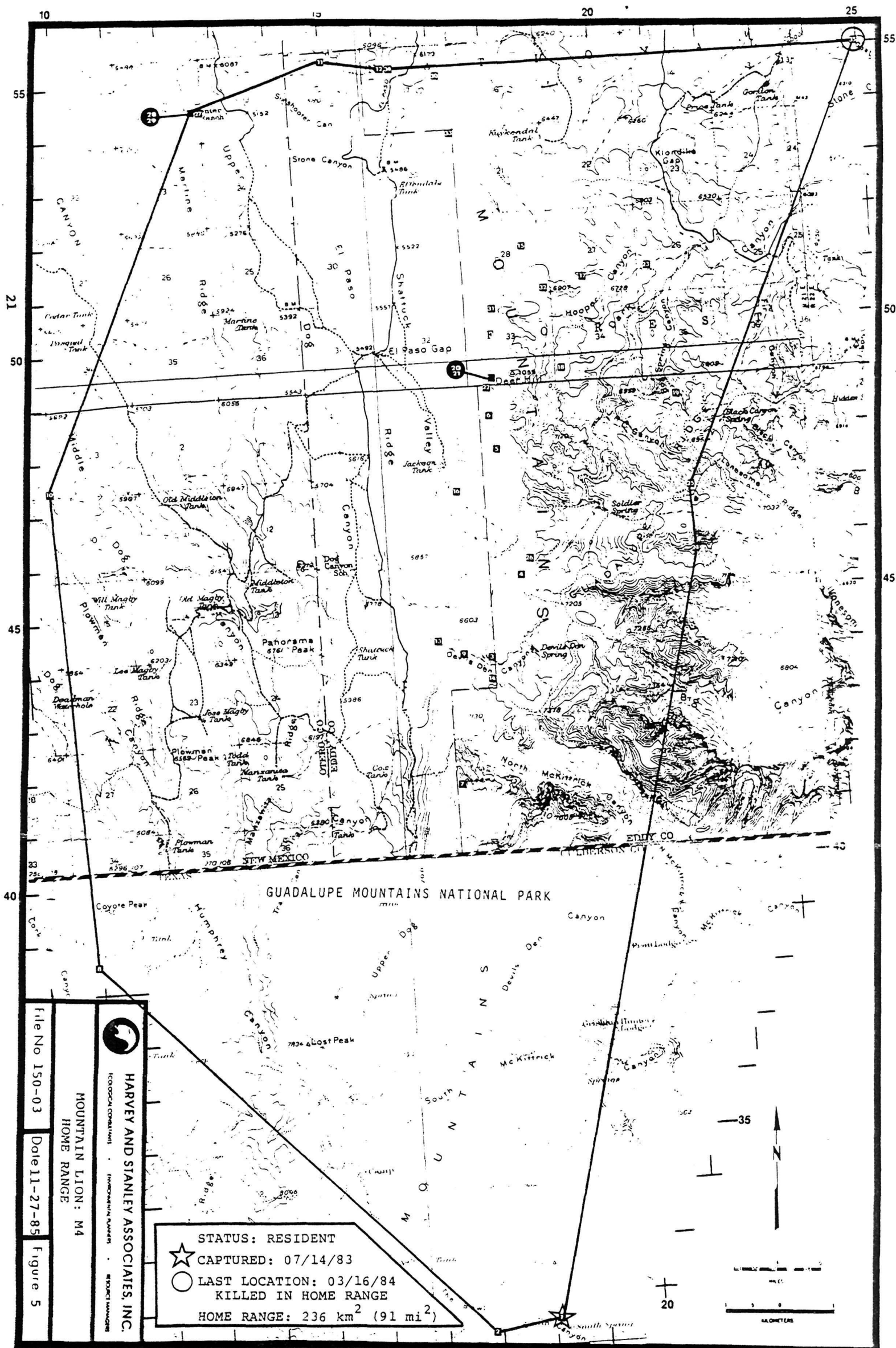
MOUNTAIN LION: M1
HOME RANGE

File No 150-03

Date 11-27-85

Figure 2



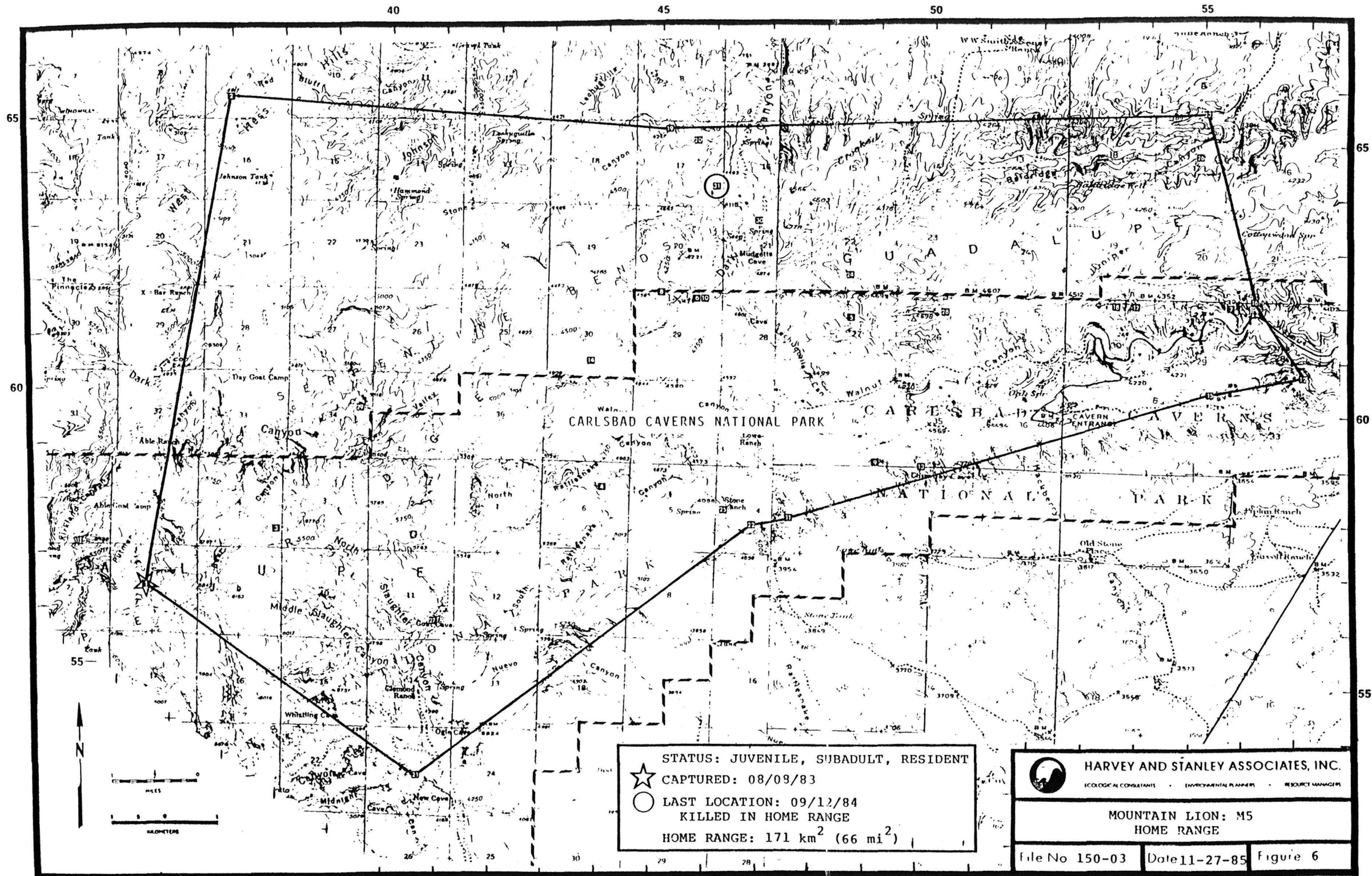


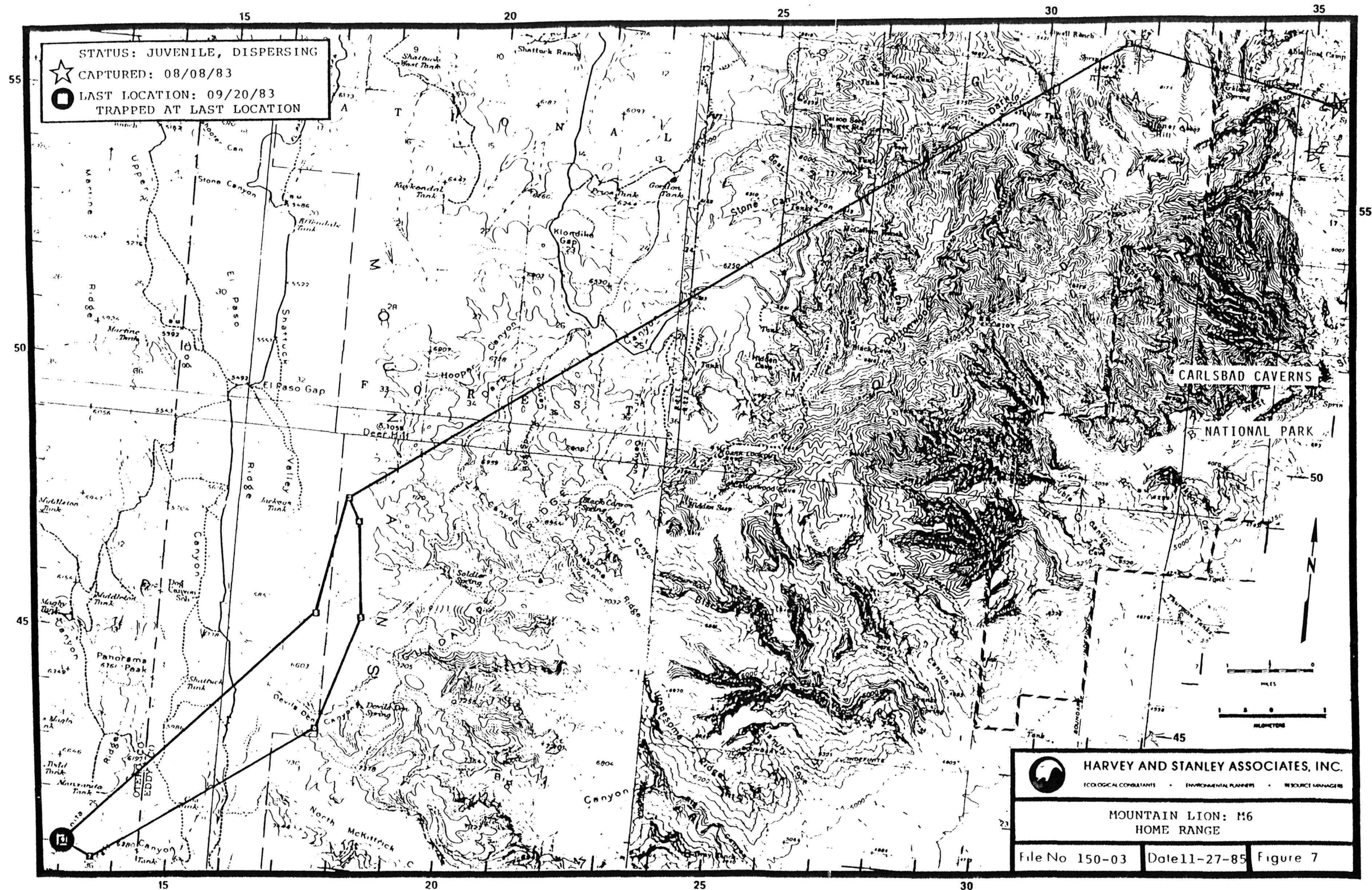
HARVEY AND STANLEY ASSOCIATES, INC.
ECOLOGICAL CONSULTANTS • ENVIRONMENTAL ANALYSTS • PROJECT MANAGERS

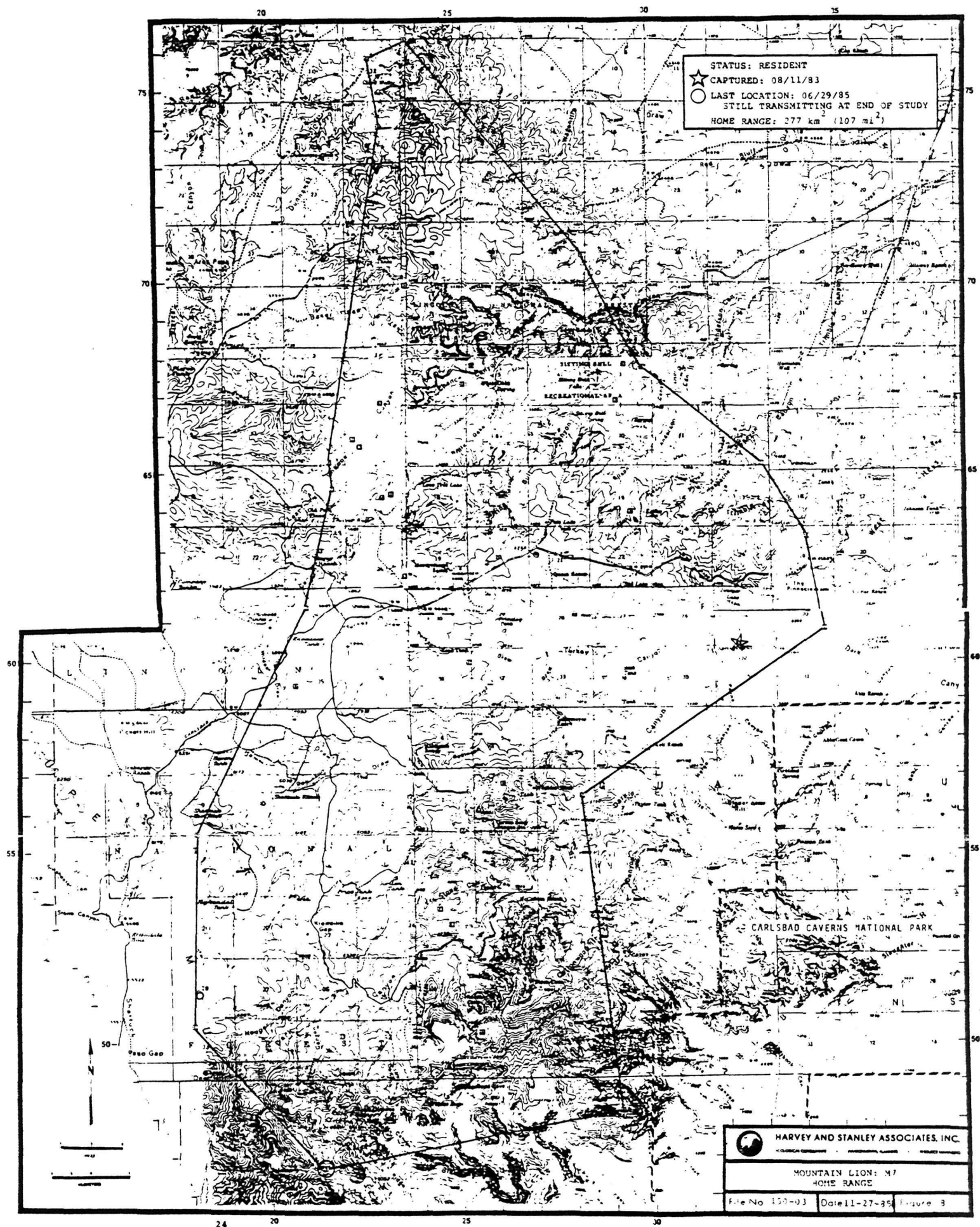
MOUNTAIN LION: M4
HOME RANGE

File No 150-03
Date 11-27-85
Figure 5

STATUS: RESIDENT
★ CAPTURED: 07/14/83
○ LAST LOCATION: 03/16/84
KILLED IN HOME RANGE
HOME RANGE: 236 km² (91 mi²)







STATUS: RESIDENT



CAPTURED: 04/10/84



LAST LOCATION: 12/26/84

SIGNAL LOST

HOME RANGE: 171 km² (66 mi²)

CARLSBAD CAVERNS NATIONAL PARK



HARVEY AND STANLEY ASSOCIATES, INC.

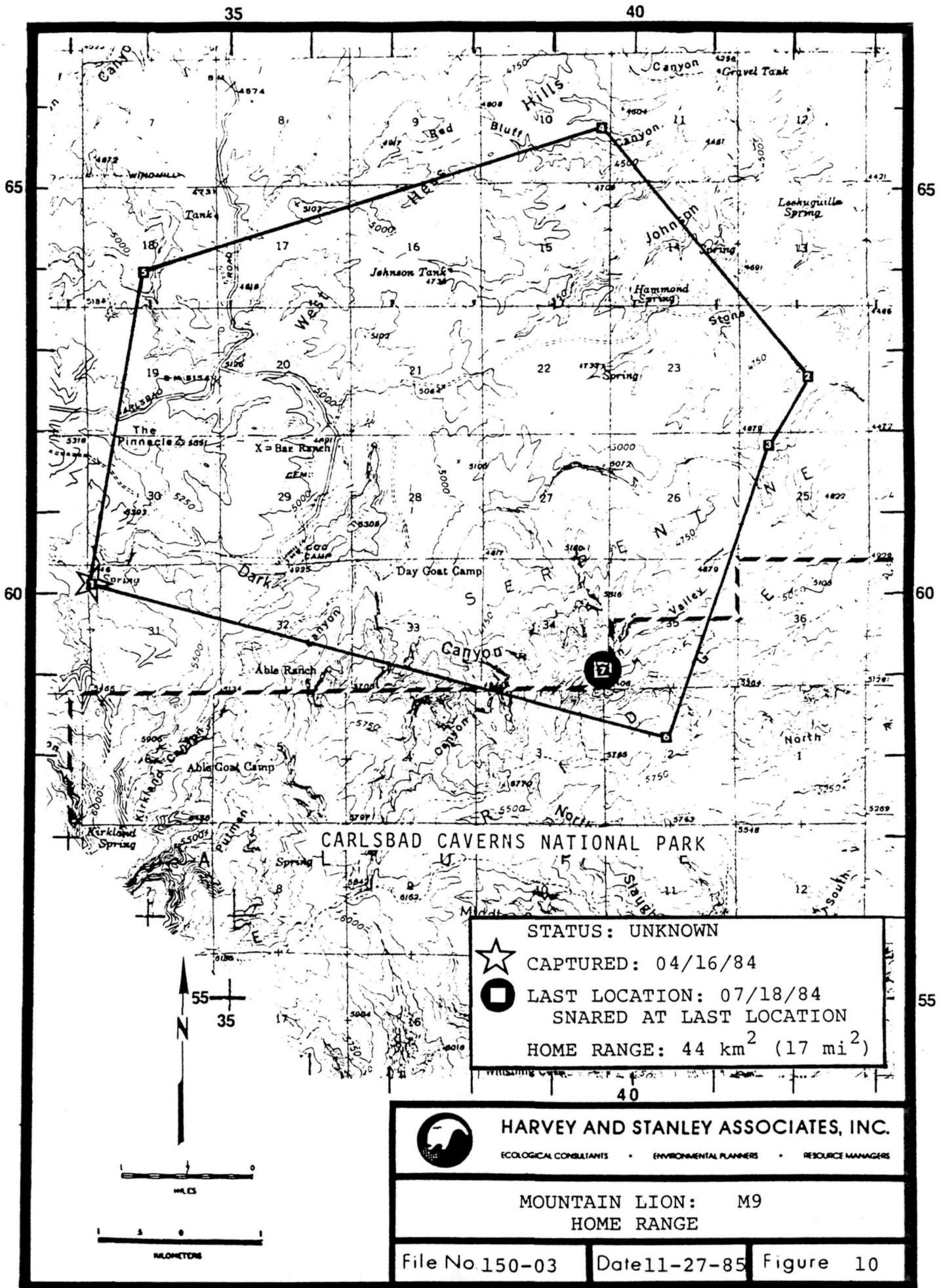
ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

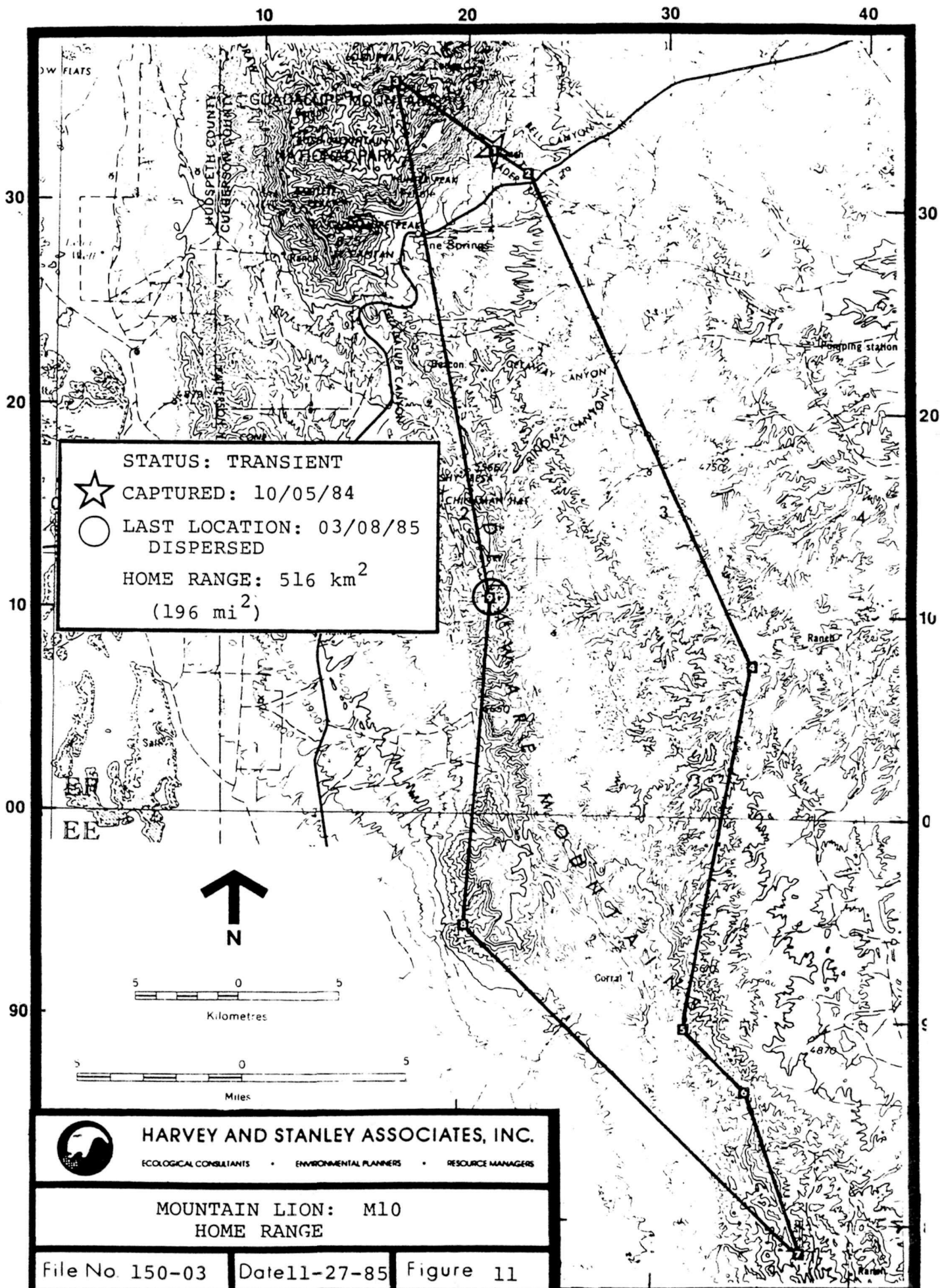
MOUNTAIN LION: M8
HOME RANGE

File No 150-03

Date 11-27-85

Figure 9





HARVEY AND STANLEY ASSOCIATES, INC.

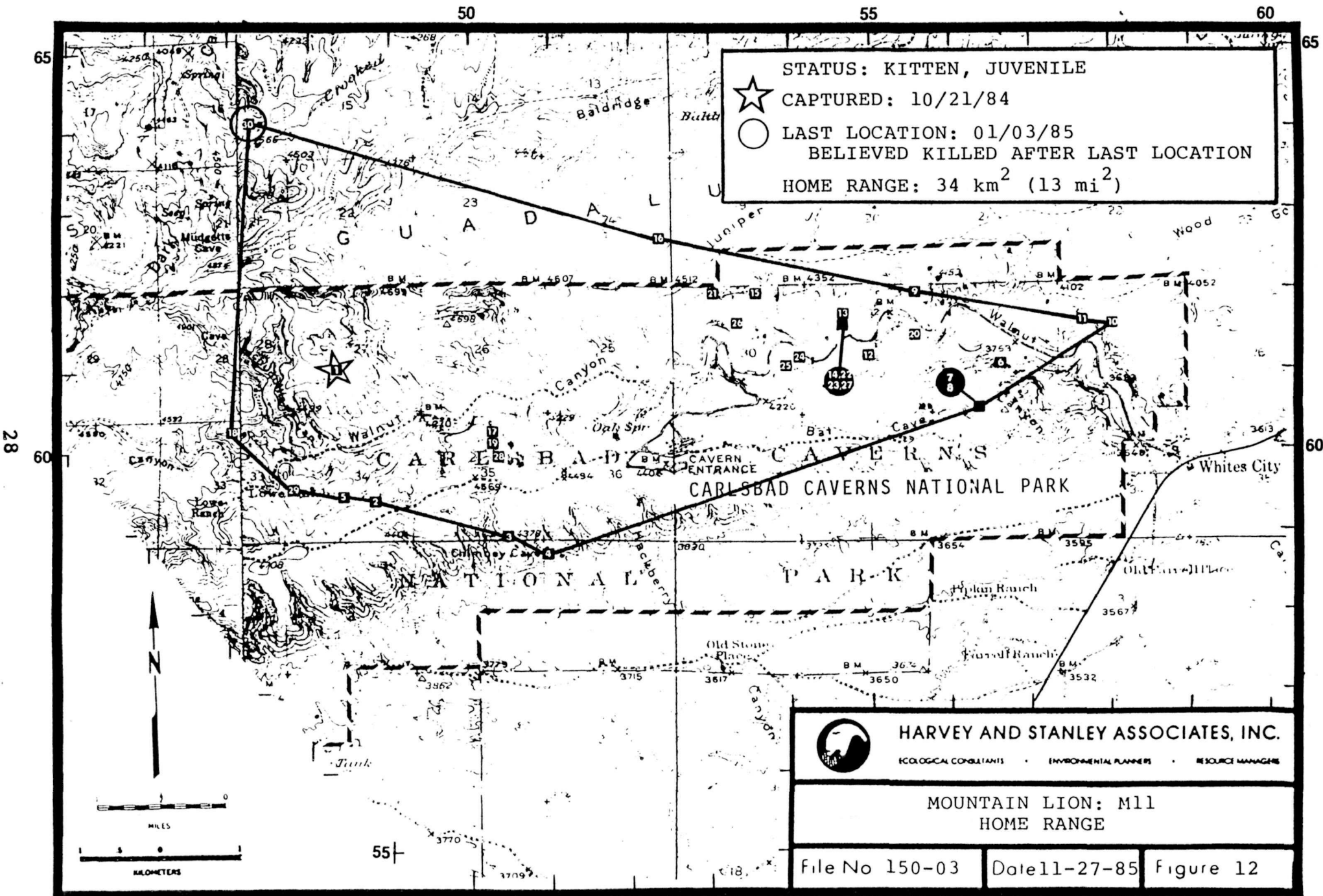
ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

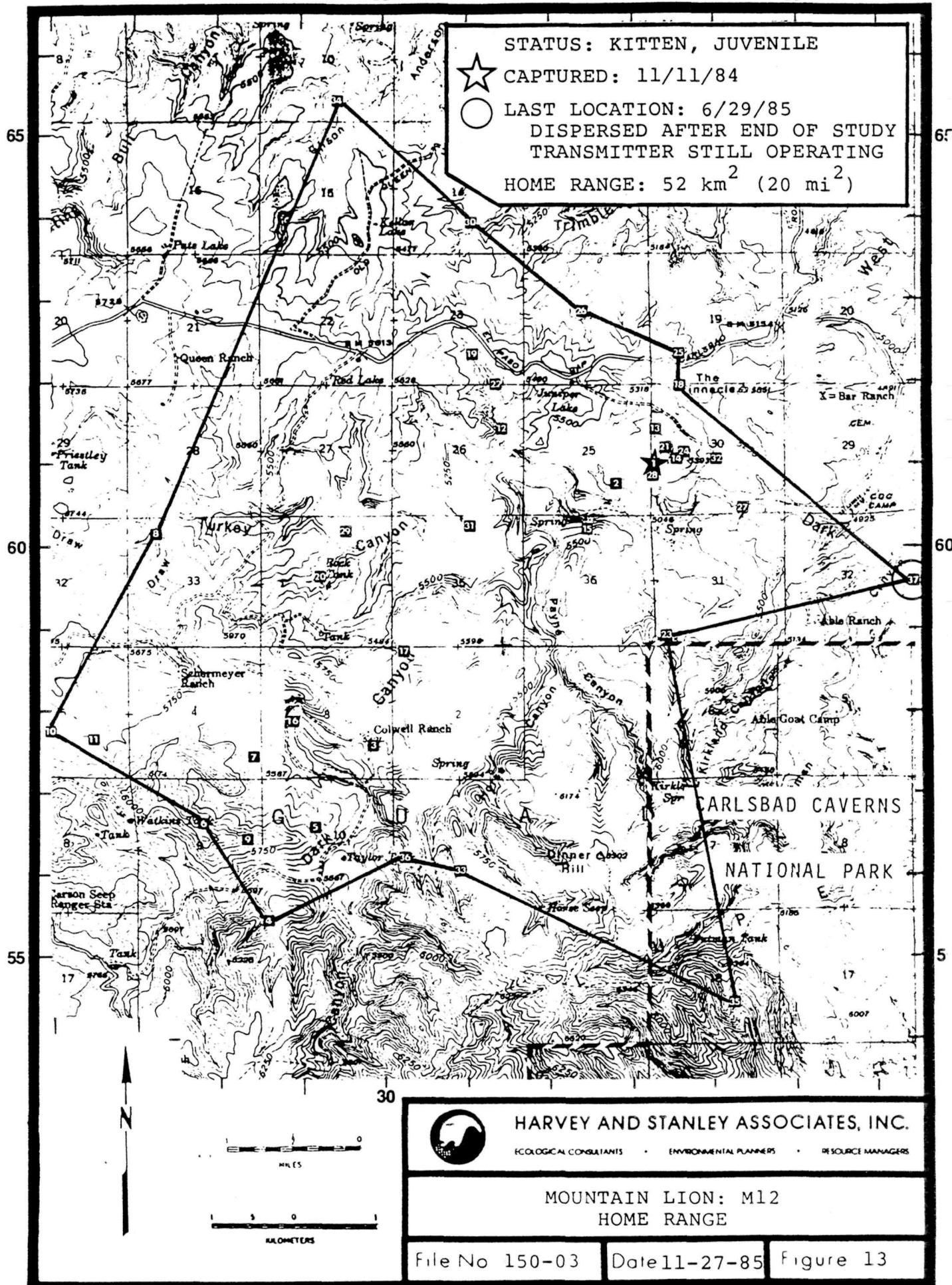
MOUNTAIN LION: M10
HOME RANGE

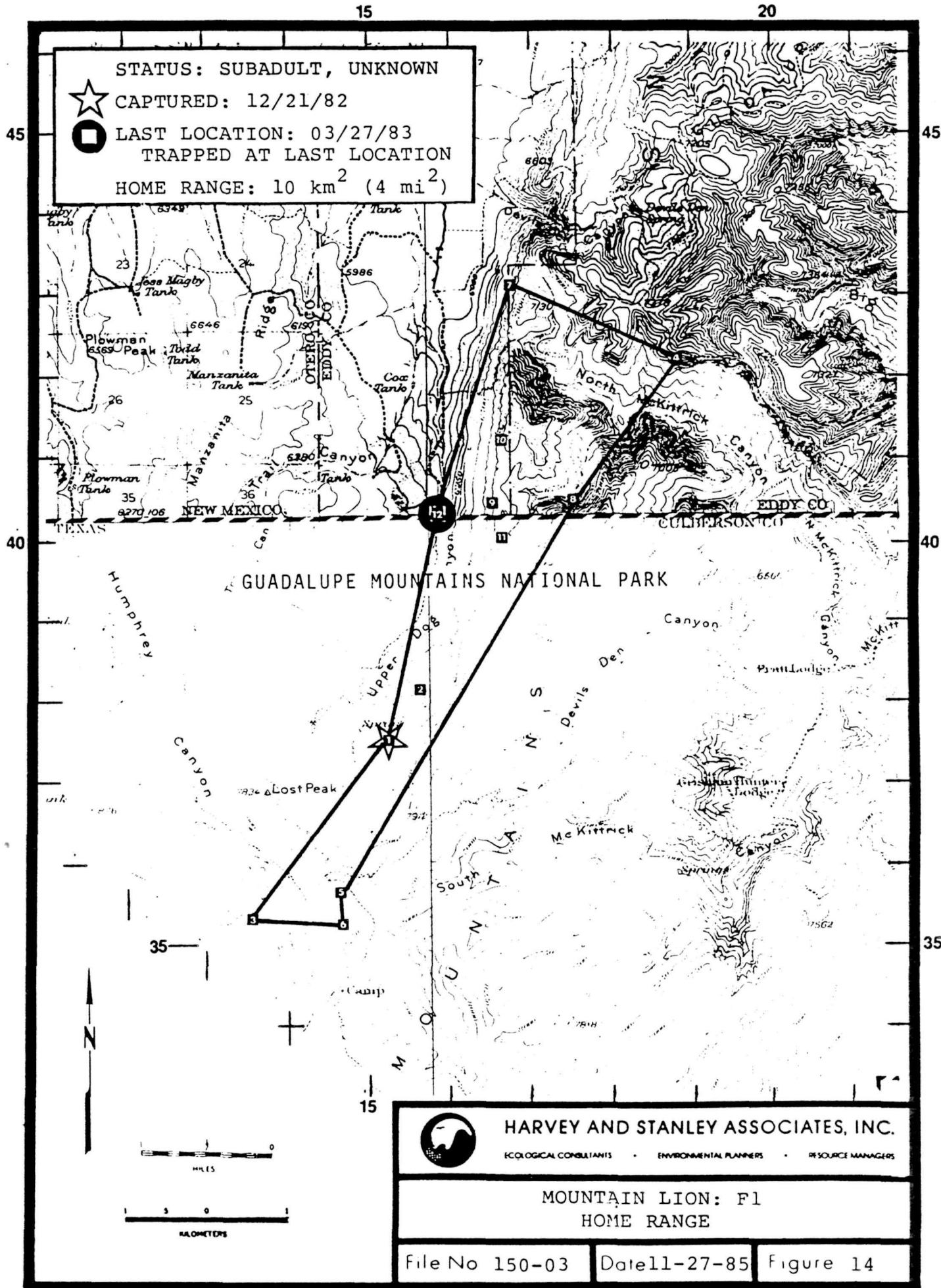
File No. 150-03

Date 11-27-85

Figure 11



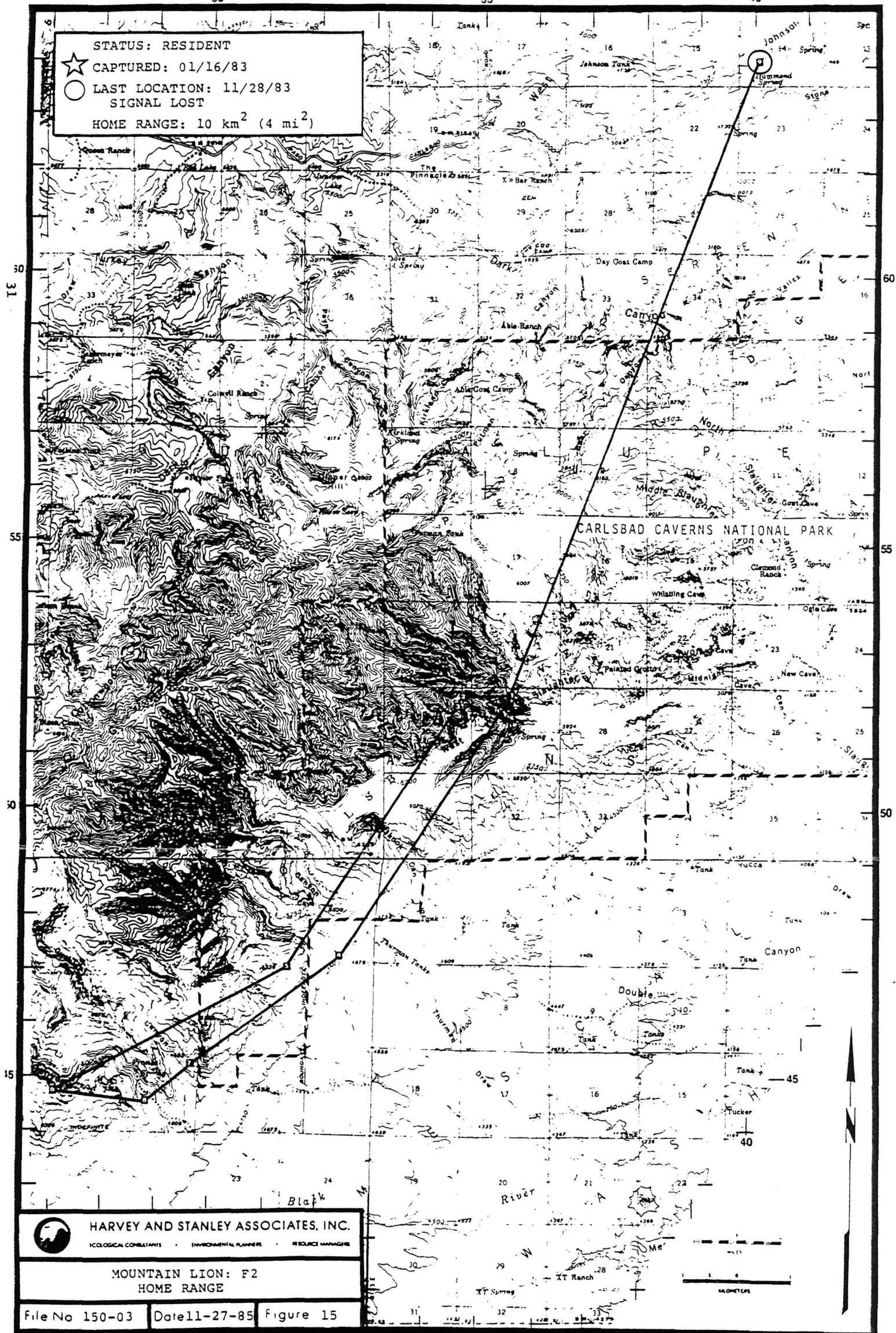




STATUS: RESIDENT



CAPTURED: 01/16/83

LAST LOCATION: 11/28/83
SIGNAL LOSTHOME RANGE: 10 km² (4 mi²)

HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

MOUNTAIN LION: F2
HOME RANGE

File No 150-03

Date 11-27-85

Figure 15

40

45

50

STATUS: RESIDENT

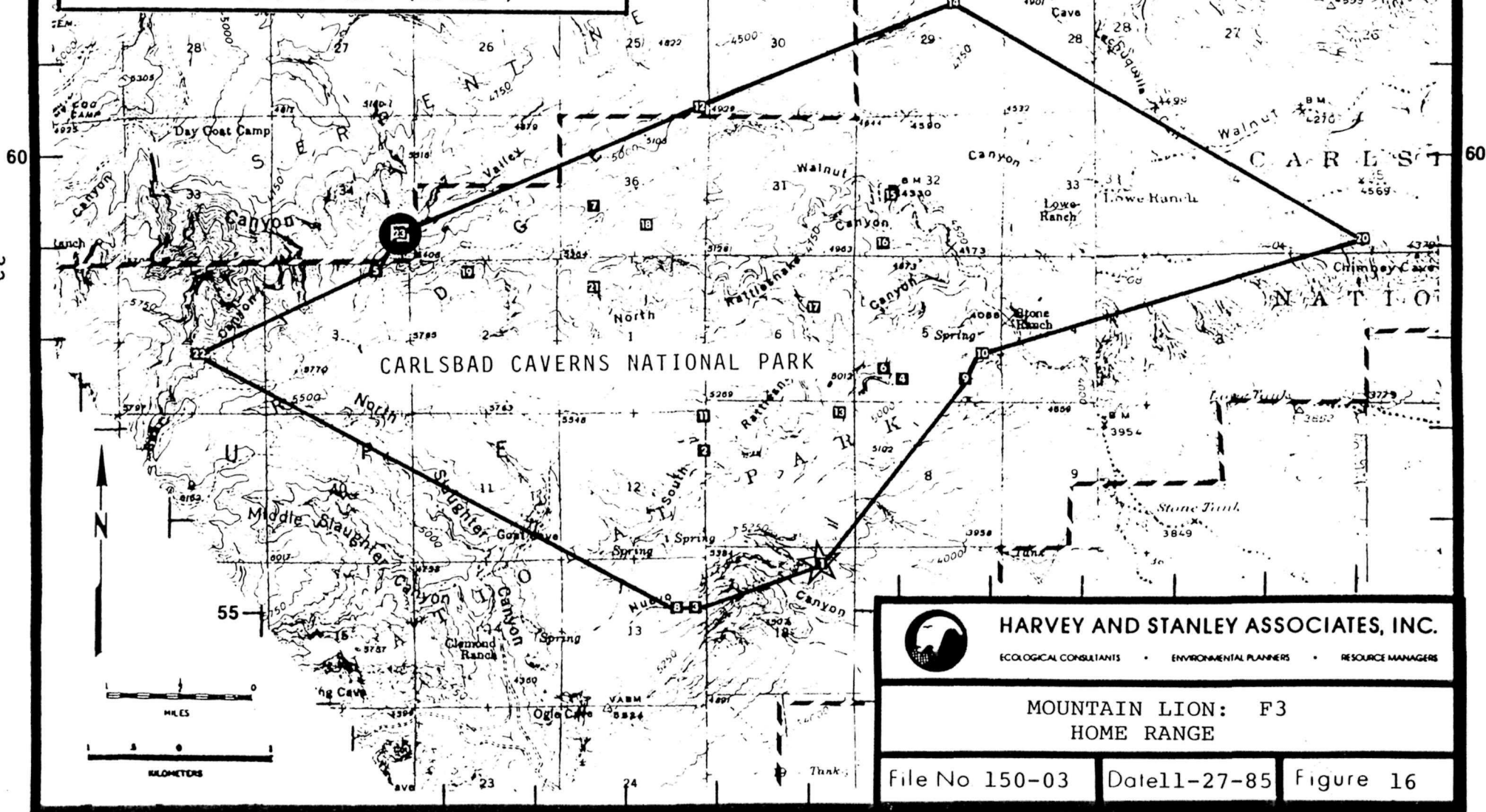


CAPTURED: 02/07/83



LAST LOCATION: 11/28/83

KILLED IN SNARE AT LAST LOCATION

HOME RANGE: 39 km² (15 mi²)

HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

MOUNTAIN LION: F3
HOME RANGE

File No 150-03

Date 11-27-85

Figure 16

40

STATUS: RESIDENT

★ CAPTURED: 06/22/83

○ LAST LOCATION: 06/19/85
STILL ALIVE AT END OF STUDYHOME RANGE: 98 km² (38 mi²)

65

60

65

60

CARLSBAD CAVERNS NATIONAL PARK



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

MOUNTAIN LION: F4
HOME RANGE

File No 150-03 Date 11-27-85 Figure 17

45

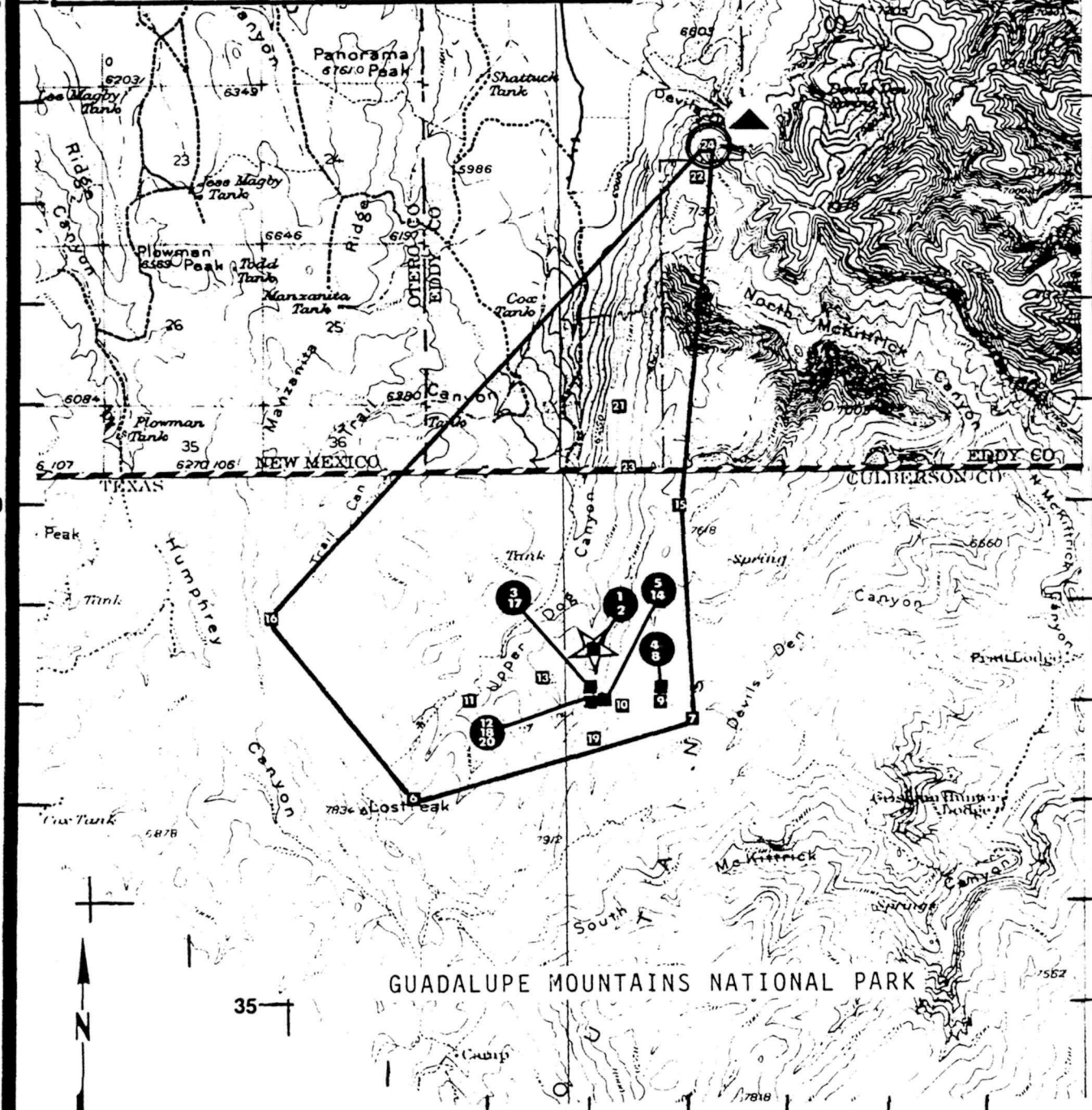
40

45

40

35

STATUS: KITTEN, JUVENILE
 ★ CAPTURED: 03/29/84
 ○ LAST LOCATION: 05/16/84
 ▲ SHOT AT LOCATION INDICATED
 HOME RANGE: 16 km^2 (6 mi^2)



GUADALUPE MOUNTAINS NATIONAL PARK



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

MOUNTAIN LION: F6
 HOME RANGE

File No 150-03

Date 11-27-85

Figure 19



STATUS: RESIDENT

CAPTURED: 04/13/84

LAST LOCATION: 05/13/84

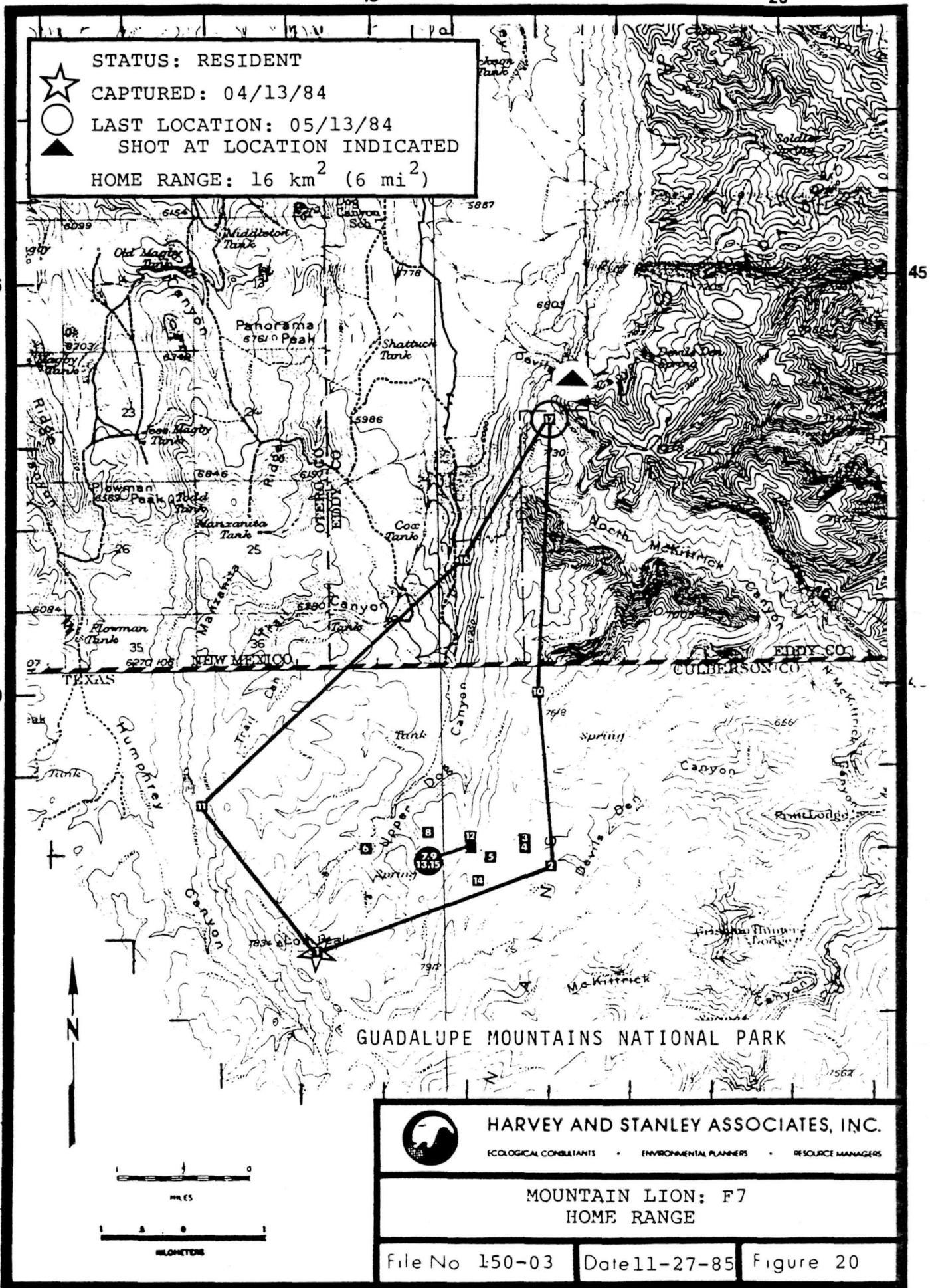
SHOT AT LOCATION INDICATED

HOME RANGE: 16 km² (6 mi²)

45

45

40



GUADALUPE MOUNTAINS NATIONAL PARK



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

MOUNTAIN LION: F7
HOME RANGE

File No 1:50-03

Date 11-27-85

Figure 20

STATUS: UNKNOWN



CAPTURED: 05/20/84

LAST LOCATION: 06/01/84
DIED OF UNKNOWN CAUSE

50

50

45

45



MILES



KILOMETERS



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

MOUNTAIN LION: F8
HOME RANGE

File No 150-03

Date 11-27-85 Figure 21

50

55

60

10, 11, 19, 20, 22,
24, 48, 49, 50

CARLSBAD CAVERNS NATIONAL PARK

CARLSBAD CAVERNS

CAVERN ENTRANCE

51, 53, 58, 59, 62,
64, 66, 67, 69, 81

STATUS: RESIDENT



CAPTURED: 10/30/84



LAST LOCATION: 06/29/85

STILL ALIVE AT END OF STUDY

HOME RANGE: 29 km² (15 mi²)

HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS

ENVIRONMENTAL PLANNERS

RESOURCE MANAGERS

MOUNTAIN LION: F9

HOME RANGE

File No 150-03

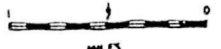
Date 11-27-85

Figure 22

50

38

60

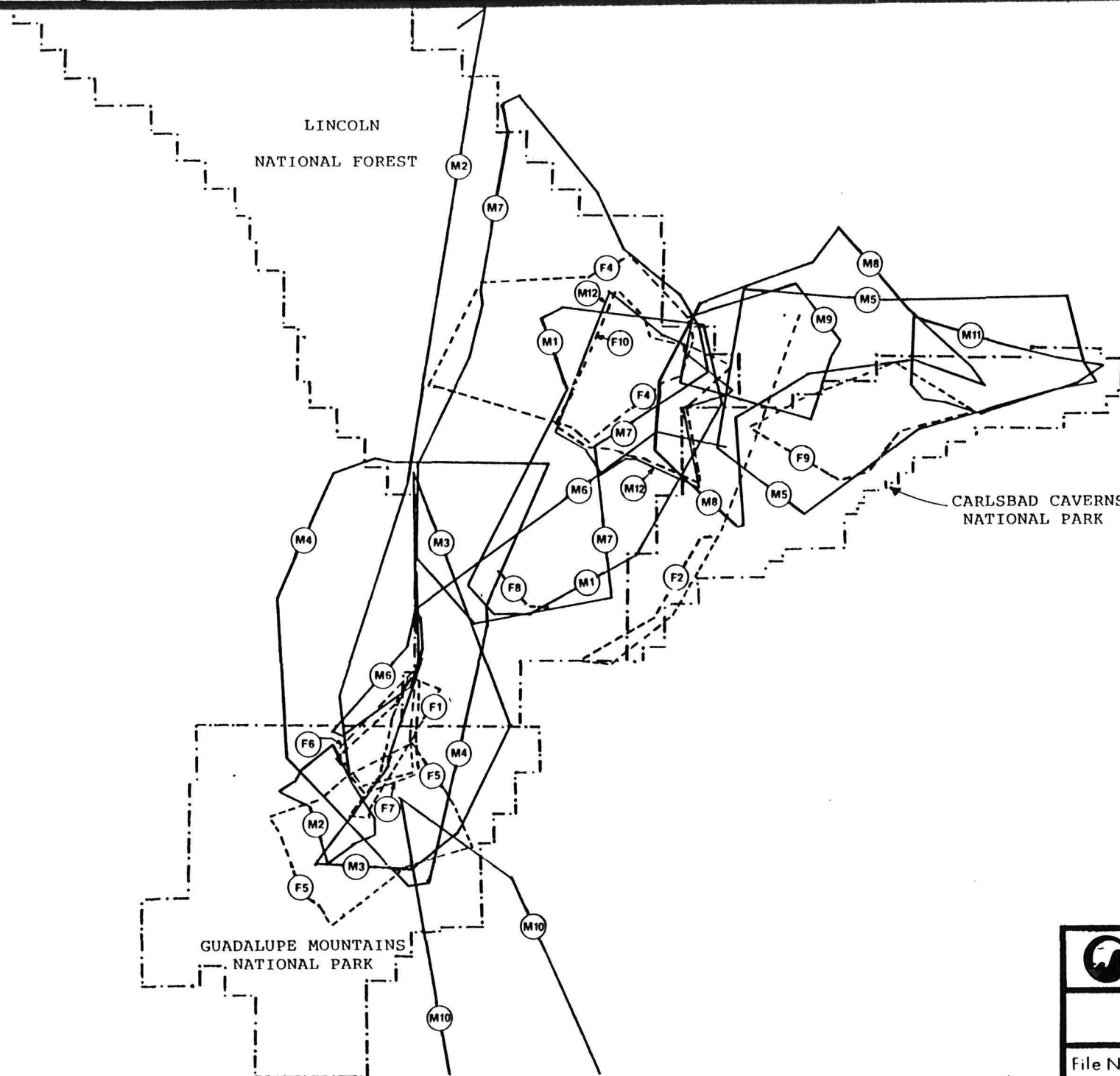


KILOMETERS



ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

File No 150-03 Date 11-27-85 Figure 23



	HARVEY AND STANLEY ASSOCIATES, INC. ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS		
	SPATIAL DISTRIBUTION OF MOUNTAIN LION HOME RANGES		
File No 150-03	Date 11-27-85	Figure 24	

The home ranges shown in Figures 2-24 illustrate several patterns which will be discussed separately in the following sections. These patterns are those of the site attachment and overlap of resident males, and resident females, the home range overlap of adult males with adult females, and the home ranges of family groups.

Resident Males--Site attachment and overlap

Resident males monitored in the study included M1, M3, M4, M5, M7, M8, and M10. As has been noted, the average home range size for adult males in the study area was 207 km^2 (80 mi^2). This is based on the home ranges of M1, M4, M7 and M8, considered representative based on comparatively large numbers of relocations over a period of at least several months. M3 was relocated only 12 times over an eight month period, M5 was a juvenile when first captured and probably in the process of dispersal, and M10 was apparently a transient. The home range sizes of these animals were therefore not included in the average figure.

The home ranges of resident males were largely exclusive, as will be seen in the following synopsis of characteristics for each of the animals.

M1-- This adult male was captured on September 3, 1982. Thirteen type 1 or 2 locations were recorded during 9 months (Figure 2) over an area of approximately 145 km^2 (56 mi^2). The last signal received on M1 was a type 3 location on July 12, 1983. This location was several miles east of his described home range suggesting either an exploration, or a larger home range. M1 may have shared a portion of his home range with M7 (see M7 below) (Figure 24). A 4 year old male was killed on the border of M1's home range in November 1982 and a young adult male was killed inside his home range in January 1983.

M3-- M3 was captured on July 1, 1983, and relocated 12 times (Figure 4) within a home range of 91 km^2 (35 mi^2) before being

trapped and killed on February 23, 1984. Three additional type 3 locations were obtained in October and November 1983 in or very near his described home range. One relocation appeared to be of an exploratory nature. M3 was found on July 12, 1983 approximately 8 km (5 mi.) north of any other relocation. He was never found in this area again. This northern location contributes to the apparent overlap of M3 with M4. Although M4 and M3 were present on the study area simultaneously, M3's presence in the area of overlap occurred prior to the arrival or return of M4. M4 apparently entered or returned to this region in August from a point further south.

M4-- Captured on July 14, 1983, M4 left the vicinity of his capture after July 28th and moved 13 km (8 mi) to the north by August 18 (Figure 5). M4, apparently site-attached to this northern area, was not found in his capture area in thirty-three subsequent relocations. He did move on several occasions into sheep range or areas bordering sheep range. There is an apparent home range overlap between M4 and M3 (Figure 24) but it is largely the result of outlying relocations in the southern portions of M4's range and the one northern location for M3. When the temporal distribution of these locations is considered it appears that their home ranges were largely contiguous with little overlap. Signals from M4 were last received on March 16, 1984. M4 is believed to have been killed in the northern portion of his range in late March 1984.

M5-- This male was captured as a juvenile on August 8, 1983 with another juvenile male (M6), presumably a littermate. His (M5's) movements during 31 relocations suggests a general trend eastward from his capture site to site attachment as a subadult in the eastern portion of his range (Figure 6). The home range of M5 covers 171 km² (66 mi²) and overlapped the home ranges of M8 and M9. However, the extreme western locations in M5's range probably represent, in part, dispersal from his juvenile home range. M9 was instrumented 8 months after M5 and was not recorded in the area of apparent overlap with M5 until 7 months after M5 dispersed eastward. Therefore, M5 and M9 are not known to have shared areas after M5 dispersed. It is possible, however, that M9 ranged over M5's juvenile home range. Although M8's home range

spatially overlaps M5's home range, the mean distance between M5 and M8 on the same day was 8.2 km ($N=7$, $SD=3.9$ km, range = 3.2-14.9 km) indicating a lack of spatio-temporal overlap. He was apparently killed in September 1984.

M7-- M7 was captured on August 11, 1983, but signals were not received from M7 until almost six months later on February 2, 1984. The magnet that activates the radio-collar may not have been removed, which would account for the delay in relocating M7. This lion's home range was 277 km² (107 mi²) between February 2, 1984 and June 29, 1985 and extended out of the northern border of the study area (Figure 8). M7 was captured inside the northern portion of M1's home range at about the time M1 is believed to have been killed. The relocations obtained since February 2, 1984 suggest that M7's home range overlapped the northwest portion of M1's home range. However, relocations for M1 in this area were obtained in January, February, and May of 1983, 3 to 7 months prior to M7's capture. Without knowledge of M7's movements during the first half of 1983 it must be concluded that M7 and M1 used the area of overlap at different times with the possible exception of July and August of 1983.

The degree of home range overlap between M7 and M4 is poorly known, because contact was lost with M4 only 1.5 months after M7 began transmitting. However, from February 2nd to July 24th, 1984, M7 used a 106 km² (41 mi²) home range which did not overlap with the area occupied by M4 prior to March 16, 1984. M7 began to use the eastern portions of M4's vacated range 8 months later in late November 1984.

M8-- M8 was about 3 years old when he was captured on April 10, 1984. He ranged over a 171 km² (66 mi²) area before contact was lost in late December 1984 (Figure 9). Six days after M8's capture, M9 was captured 3.7 km (2.3 mi) to the west. M9 was approximately 5 years old when captured. M9 was snared in mid-July 1984 and had been relocated only 7 times. Consequently little was known of his home range or site attachment. The home ranges of M8 and M9 appear to overlap considerably. M8's pattern of movement in April and May indicates that he left this area of overlap within 21 days and maintained an exclusive home range east of M9.

From late July to October 1984, M8 centered his movements on the northern edge of what had been M9's range. Occasionally he made movements into M9's vacated range. By October 19th M8 shifted his home range into the region previously occupied by M9 and remained in this area until contact was lost with M8 in late December 1984.

M10--M10, a three year old transient male, was captured on October 5, 1984 on the east side of GUMO, but only 9 locations were obtained before contact was lost in March 1985 (Figure 11). His home range polygon encompasses 516 km² (196 mi²), which is significantly larger than that for M7 (277 km² (107mi²), the largest home range of a resident male. M10 moved a minimum distance of 117 linear kilometers (73 mi) between the 9 sequential locations. He stayed briefly in GUMO and made long ranging movements into the southern end of the Delaware Mountains. Despite periodic aerial monitoring efforts in April and May, and an extensive effort in June that reached 75 miles south of the study area, additional signals were not received.

Resident Females--Site attachment and overlap

Resident female mountain lions monitored during the study included animals F2, F3, F4, F5, F7, and F9. As noted above, the average home range size for adult females was 59 km² (23 mi²), based on the home ranges of F3, F4, F5 and F9. Females F2 and F7 were poorly known, with only 9 relocations for F2 and only 1 month of transmitting for F7. Their home ranges may not have been adequately represented, and they are therefore not represented in the above average.

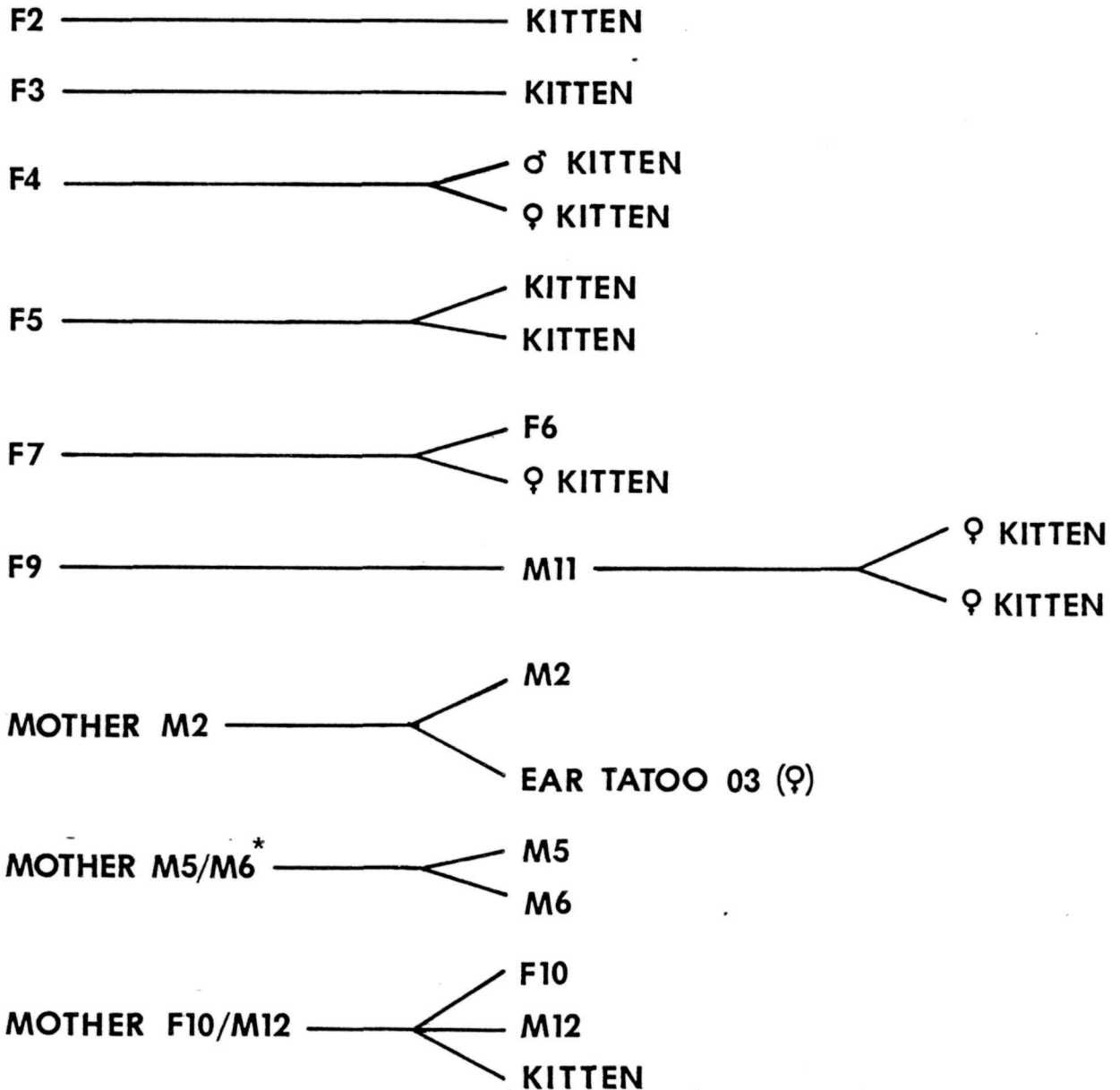
Female home ranges overlapped to some extent, as is seen in the following individual descriptions. Figure 24A illustrates known relationships between resident adult females and their kittens, as well as those of littermates.

F2-- F2 had at least one 4-5 month old kitten when she was captured on January 16, 1983. Eight of the 9 locations obtained

**RESIDENT
ADULT
FEMALE**

**1st KNOWN
LITTER**

**2nd KNOWN
LITTER**



* May not have been
resident in study area



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

KNOWN RELATIONSHIPS

File No 150-03

Date 11-27-85

Figure 24A

on F2 indicated that she, and presumably her kitten(s), inhabited the western boundary of CACA through May 26, 1983. No further signals were received until July 14, 1983 when F2 was relocated on ranch B, by the New Mexico Game and Fish Department. This location was 22.5 km (14 mi) north of the May location and 13 km (8.2 mi) from her known home range. This was the last relocation obtained on F2. The presence of kittens indicates that F2 was probably a resident adult. Because of limited relocation data, little can be said about the size of her home range though the presence of kittens suggests that she was site-attached in the region indicated by her home range polygon (Figure 15). The last relocation may have been an exploration or may indicate that her home range was larger than indicated. The distance moved in this exploration was not equalled by another adult female with or without kittens.

F3-- Twenty-three locations were obtained on F3 between her capture on February 2, 1983 and when she was snared on or about November 28, 1983 (Figure 16). Her home range covered 39 km² (15 mi²). F3 was accompanied by at least one 4-5 month old kitten at the time of her capture. No evidence of the kitten was found in July 1983 during observations and tracking efforts. From February to November 1983 she ranged primarily within CACA and was never located on sheep range. Three kittens were killed in February 1983 north of F3's home range. This indicates that there was a family group in this area, but it is not known if their home ranges overlapped.

F4-- Between her capture on June 22, 1983 and June 19, 1985, F4 ranged over a 98 km² (38 mi²) area (Figure 17). Her first known litter, 1 male and 1 female, was born in early June 1984. A young adult female was killed within the eastern portion of her home range in October 1983. A mature adult female was killed 1 km (0.6 mi) outside F4's known home range in January 1984. The home range of the F10-M12 family group from November 1984 to June 1985 overlaps the eastern third of F4's home range and most of the western half of F10 and M12's home range. The presence of this family group and neighboring females indicates that F4 has shared her home range with at least 2 adult females.

Overlap was noted between the F4 and F10-M12 family groups on March 8, 1985. The family groups bedded down 1.2 km (0.8 mi) from each other, became active at approximately 1730 hours, and apparently came in contact with each other around 2045 hours. They traveled in association for approximately 2.0 hours over a minimum distance of 1 km (0.6 mi) before radio contact was lost.

F5-- A total of 67 relocations were obtained on F5 after her capture on June 28, 1983. All relocations fall within a 60 km^2 (23 mi^2) area (Figure 18). F5's home range overlapped the home ranges of at least 2 other adult females and possibly a 3rd. M2, presumed to have been in his mother's home range at the time, may have overlapped approximately one quarter of F5's range prior to his dispersal. F7 probably gave birth to F6 and another female in October 1983 along the northern edge of F5's range. Tracks of another mountain lion were found along the eastern escarpment of GUMO in July 1983. The tracks were believed to be those of a female, based on the size of the track.

F7-- F7 was captured on April 13, 1984 and had 2 kittens (F6 and littermate) from a mating in July or August 1983. This mating was 2-3 months after M2's dispersal and 1 month after F5's capture. What is known of F7's home range was determined from 17 locations during 30 transmitting days (Figure 20) and from 24 relocations over 49 transmitting days for F6 (Figure 19). Tracks of this family group were first noted in December 1983. The home range of F7 and her kittens encompassed 16 km^2 (6.0 mi^2) yet seventy-one percent of the locations obtained on F6 from March 29th to May 16th were grouped in a 2.2 km^2 (0.8 mi^2) area of broken terrain. F7's home range probably bordered and possibly overlapped the home range of F5 during the fall and winter of 1983-84, and a portion of the spring of 1984. If F7 resided in the region for at least a short time before mating then all three (F5, mother of M2, and F7) may have shared areas early in the summer of 1983.

F9-- Captured on October 30, 1985, F9 occupied a 39 km^2 (15 mi^2) area through June 1985 (Figure 22). In late March and early April two young adult females were shot during control efforts approximately 1.5 km (0.9 mi) north of F9's home range. It is not known

if the home ranges of the two females overlapped the home range of F9.

Home Range Overlap of Adult Males with Adult Females.

The home range of an adult resident male usually overlaps or is adjacent to the home ranges of several adult females. Estimates of the number of adult females encompassed in a resident male's home range is determined by identifying all known adult females within the home ranges of M1, M3, M4, and M7.

M1-- Three or four adult females occurred within M1's home range. One of these females was F4, and 2 were sport hunting mortalities. A possible fourth female was the mother of 2 radio-collared juveniles (M5 and M6) which were captured about the time of M1's disappearance and reported death. Additionally, F8's range may have overlapped with M1's which would make her the fifth adult female within M1's home range. She was captured a year following M1's death, in what had been the southern end of his home range. She was approximately 5 years old which suggests that she was a resident in the area of her capture. She died within a week after capture, so confirmation of her resident status was not possible.

M3-- A minimum of 2 females lived within M3's home range. F5 occupied most of the southern end of M3's home range. M3 was captured within the home range of F7 on July 1, 1983, which was approximately the time she bred. F7 was captured in April 1984 (10 months later) with 5-6 month old kittens. Tracks indicated that a third female with juvenile kittens was present in the region of M3's home range not occupied by F5 or F7 during May 1984, 3 months after M3 was trapped.

M4-- Signals were received from M4 for a period of 8 months, but there were no females confirmed to be within his range during that period. Tracks suggested that an adult female occurred within his range, but they were within a size range which could not be conclusively assigned to a particular sex. F8 and an additional adult female with kittens were identified in or near

M4's former home range 2 or 3 months after his disappearance. The home range of the female with kittens was near the southern portion of M4's home range and probably also overlapped M3's range as noted above. Additionally, a subadult female was trapped within M4's home range in January 1984.

M7-- M7's home range overlapped with those of 2-4 females. First, his home range encompassed virtually all of F4's home range, and she remained there through June 1985. Second, a 10 year old lactating female was shot near the northern end of his range in April 1985. Two additional adult females were killed in the area before sufficient data was collected to describe M7's home range, so spatio-temporal overlap was not confirmed. The first was a young adult female that was shot on the border of his range in October 1983. The second was a 3-4 year old female that was trapped and killed within his home range in January 1984.

Family Groups.

Four adult females (F4, F5, F7, and F9) with offspring up to 7 months old were monitored during the study. These females' home ranges when they had these young kittens averaged 20 km^2 (8 mi^2) but ranged from 13 km^2 (5 mi^2) for F5 to 31 km^2 (12 mi^2) for F9.

F4 Family Group-- F4 ranged over a 57 km^2 (22 mi^2) area from June 22, 1983 to June 8, 1984, a period when she was apparently without kittens. She gave birth to 2 kittens in mid-June 1984, and her home range size from June 25th until the kittens were approximately 6 months of age was 21 km^2 (8 mi^2). Tracks found in February 1985 suggest at least 1 kitten remained. Between February and June 1985, F4 expanded her total home range to 98 km^2 (38 mi^2) with movements to the east and west. It was not determined if the kittens still accompanied her during this expansion, but if present they would have been 7-12 months old. Figure 25 illustrates F4's home ranges during these periods with and without kittens in comparison to her described total home range.

F5 Family Group. F5 moved over an area of 52 km² (20 mi²) from June 29, 1983 to November 27, 1984, a period when she was apparently without kittens. Tracks were discovered in December 1983 which suggested that F5 might be accompanied by juvenile offspring, but intensive monitoring and recapture efforts during March 1984 showed no confirming evidence. Additional monitoring efforts in November 1984 showed no sign of kittens. F5 gave birth to two kittens sometime in December, 1984. Her home range during the period when her kittens were 0-6 months old encompassed a 13 km² (5 mi²) area of rugged terrain in the eastern portion of her range. Tracks found in June 1985 suggest that she was still accompanied by at least 1 kitten. Her total home range was 60 km² (23 mi²) during the study. The comparative ranges are illustrated in Figure 26.

F7 Family group-- This family group was first detected by tracks found in northern GUMO in December 1983. F7, a three year old female, had two female kittens sometime in November, 1983. The family group resided inside GUMO within the higher elevations of Upper Dog Canyon. One of the kittens (F6) was radio-collared in late March, and F7 was captured in April, 1984. From March 29th to May 16th, the family group had a home range of 16 km² (6mi²), with seventy-one percent of the locations grouped in a 2.2 km² (0.8 km²) area within GUMO.

When the group was first detected in December, there were no reported depredations on Ranch C, which immediately adjoins their home range. Even though they were not radio-collared at the time, this suggests that they confined their movements within GUMO. However, as F7 was recovering from her immobilization on April 13th she regurgitated sheep remains, which was the first indication that the family group was ranging into the neighboring ranch. The family group continued to use bed sites within the National Park as reported depredations from the ranch continued to escalate. When the kittens were approximately 6 months old (late April and early May), the family expanded their home range toward the sheep pasture. On May 12th and 13th, they extended their home range north of the park while making nocturnal movements into the sheep pasture. F7 was killed during control

efforts on the morning of May 14th and both kittens were killed on May 17th.

F9 Family Groups--F9 was monitored while traveling with a 5-7 month old kitten (M11), while alone after M11 disappeared, and while with 0-6 week old female kittens from a new litter (Figure 27). When she was with M11, she moved over an area of 31 km^2 (12 mi^2) (Figure 27). M11 disappeared in early January 1985 and F9 travelled alone over a smaller area of only 16 km^2 (6 mi^2) through mid-May, 1985. She gave birth to 2 female kittens in late May 1985 and through the kitten's 6th week her diurnal locations indicate a home range of only 1.5 km^2 (0.6 mi^2). Her total home range was 39 km^2 (15 mi^2).

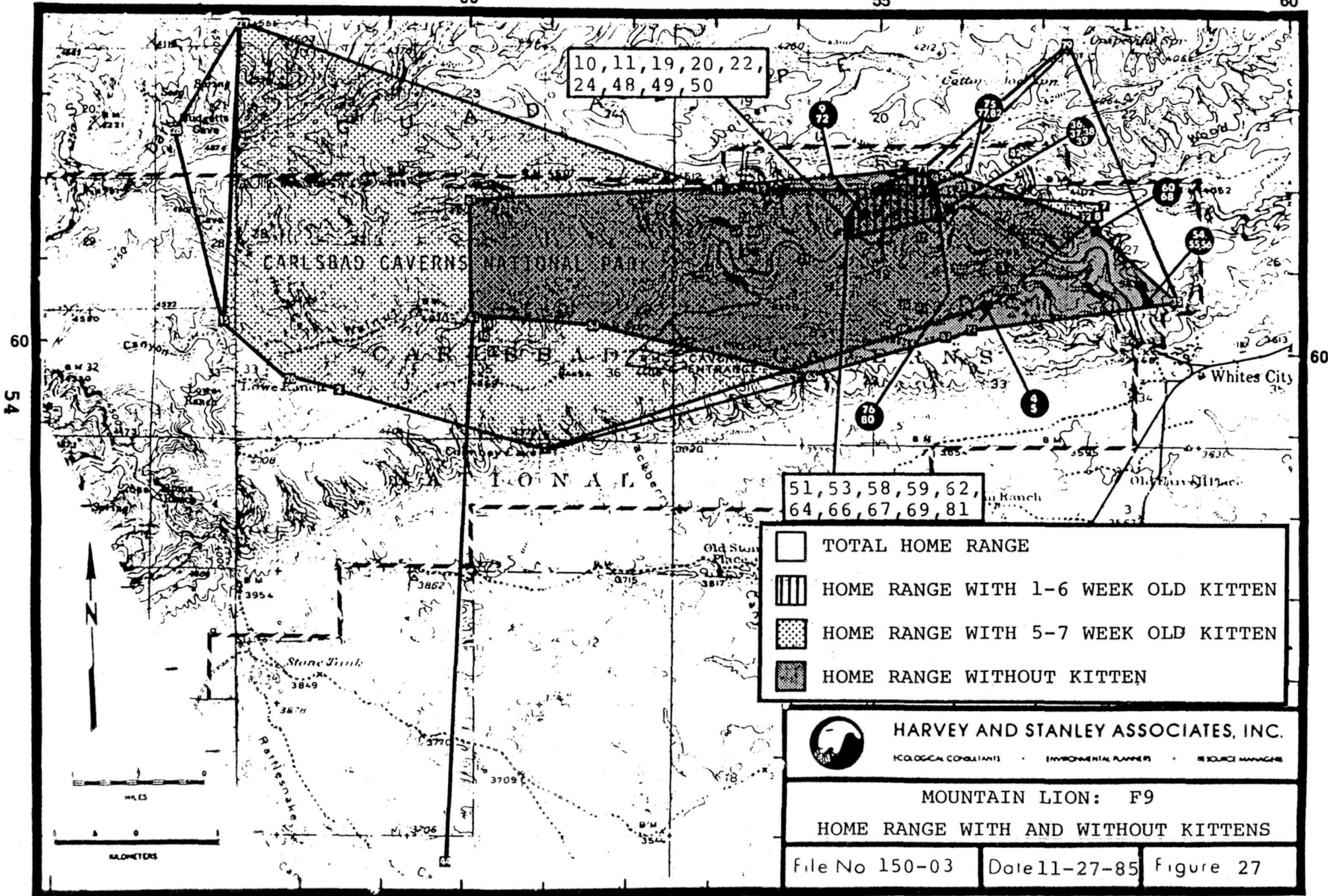
F10/M12 Family group--This family group consisted in November 1984 of an uncollared adult female; an uncollared kitten; F10, a female kitten; and M12, a male kitten. F10 and M12 often bedded down near each other. They synchronously expanded their home range, as is seen in M12's locations 34, 35, and 37 (Figure 12), and F10's locations 25, 26, and 28 (Figure 23). Neither F10 nor M12 dispersed before the study ended in June, 1985, but Park Service personnel report that both animals dispersed south into Texas after the end of this study.

M2 Family Group-- The M2 family group consisted of M2, a radio-collared male kitten; his mother, an uncollared adult female; and a female littermate, that was ear-tattooed but not radio-collared. This family group resided in West Dog Canyon and the higher elevations of South McKittrick Canyon in GUMO from December 1982 until M2 dispersed in May 1983 (Figure 10). M2's home range 1 month before his dispersal encompassed 13 km^2 (5 mi^2). M2 moved north along the axis of a major ridgeline beginning in mid-April 1983, expanding his home range to 18 km^2 (7 mi^2). The ear-tattooed littermate (03) apparently expanded her home range concurrently, as she was killed in a sheep pasture north of the M2's known home range on May 13th. There were depredations reported from that period. M2 passed through the same sheep pasture on May 18th, but three days later he was 12.5 km (7.8 mi) further north as he dispersed from his natal home range.

50

55

60



50

DISPERSAL

Data were collected regarding the dispersal of 3 yearling male mountain lions from their juvenile home ranges.

M2-- M2 was captured at approximately 6 months of age and occupied a home range of 18 km^2 (7 mi^2) before dispersing at an age of 12-14 mos. (Figure 3). M2, apparently with an ear tattooed littermate (Tattoo 03), extended his range into sheep pasture just prior to his dispersal in early May 1983. His littermate was trapped on May 13th. M2 was relocated on the sheep range on May 18th. On May 21 he moved 12 km (7.5 mi) north of his last location. On June 29th he was relocated 48 km (30.0 mi) north of the center of activity of his natal home range. He remained in that area through August and was snared sometime in August or September 1983.

M5-- M5 was captured August 8, 1983 with M6, believed to be his littermate. They were approximately 12-14 mos. of age. M5 made several wandering movements before gradually moving east (Figure 6). Fifty days after his capture M5 was 9 km (5.6 mi) east of his capture site but traveled a minimum of 23 km (14.3 mi) in the interim. M5 never returned to his capture site or to the area of his second relocation on August 30th, 1983. However, on August 29, 1984 as a young adult male, he came within 2.7 km (1.7 mi) of a location obtained on August 18, 1983 while he was a juvenile. M5 and M6 may have already dispersed an unknown distance together prior to their capture.

M6-- M6, believed to be the littermate of M5, was also approximately 12 months of age at capture. Ten days after capture, M6 had moved 20 km (12.5 mi) west of his capture site. During the next 33 days he occupied an area of 8.5 km^2 (3.3 mi^2) the shape of which was influenced by movements into sheep range (Figure 7). The center of activity in the briefly occupied home range was 22 km (13.8 mi) from his capture site. M6 was trapped and killed on the sheep range September 20, 1983.

No dispersals of immature females were observed. F10 and her littermate M12, both 12-13 months old, were enlarging their home ranges at the conclusion of field efforts in June 1985. F1, a subadult female, used a 10 km^2 (4.0 mi^2) area for the period of 86 days that she was alive and radio-collared (Figure 14). During this time no obvious dispersal or transient movements were noted. Given the relatively young age of M2 and M6 at dispersal, F1 probably dispersed prior to being captured and may have been in the early stages of establishing residence.

MOVEMENT

The distance that radio-collared mountain lions moved between relocations was computed for intervals of 1-10 days. These data were then compared for three categories; adult males, adult females, and adult females with 5-12 month old offspring (Table 4, Figure 28). Small sample sizes preclude critical analyses of differences between all age and sex categories.

The analysis of the data reveals several trends (Figure 28). In general, adult males travel further than adult females, and females with 5-12 month old offspring travel the shortest distances. Statistical analysis shows that adult females without kittens moved significantly farther distances at 1,2,4, and 7 day intervals and shorter distances at 10 day intervals than did females with 5-12 month old offspring (t-test, $P < 0.05$, 1df). Adult males moved significantly farther at 5,6, and 7 day intervals than adult females without dependant young (t-test, $P < 0.05$, 1 df). The maximum distance between relocations 1 day apart (1 night) was 7.7 km (4.8 mi) for M5, a young adult male. The greatest distance between relocations 2 days apart was 15.0 km (9.4 mi) for M3, a mature adult male.

Table 4. Mean airline distance moved (X) from an initial relocation to relocations 1-10 days later in the Guadalupe Mountains, 1982-1984.

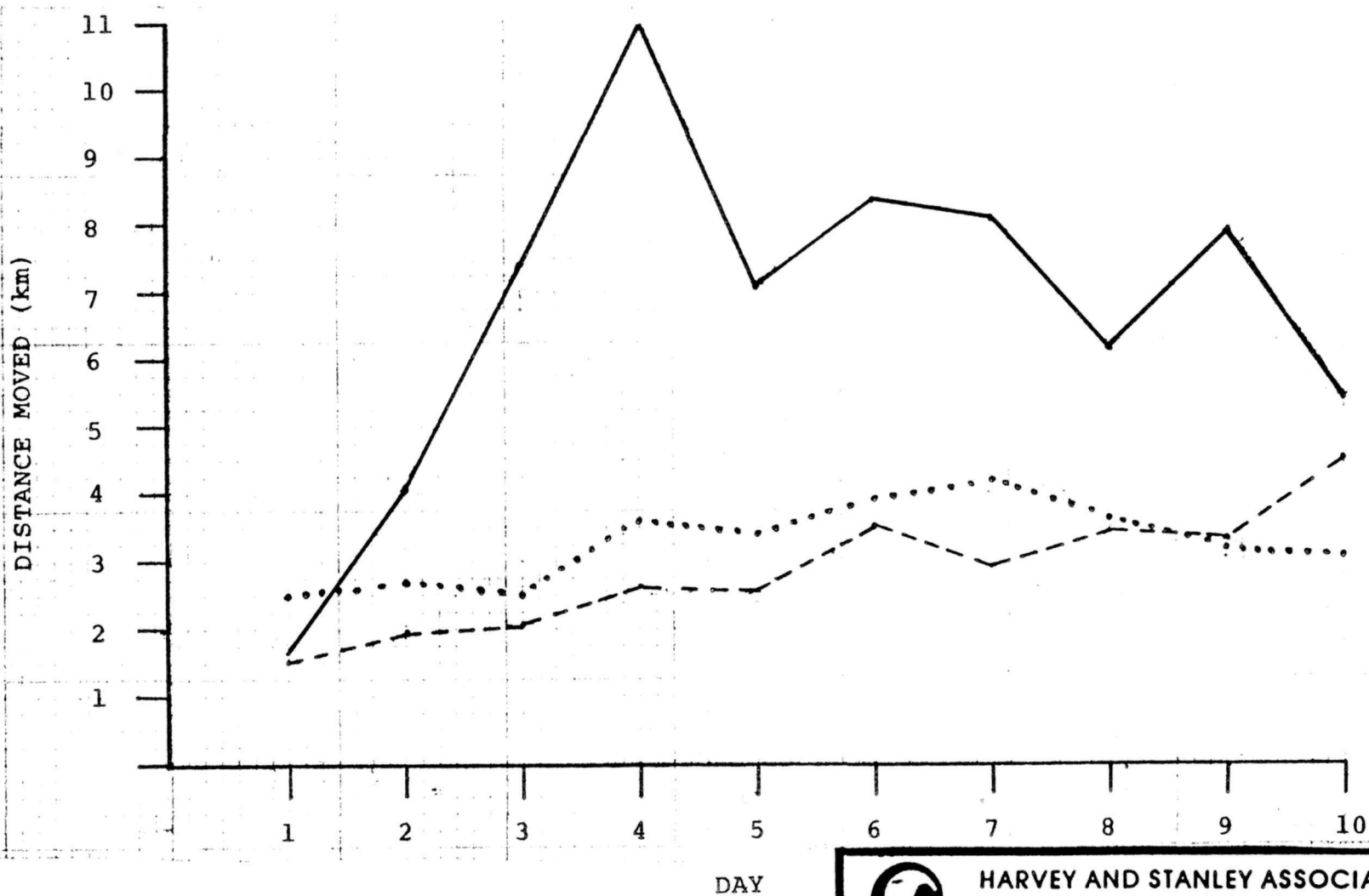
Day	Age and Sex Category											
	Adult Females with 5-12 mo Offspring ¹				Adult Females without Kittens ²				Adult Males ³			
	N	X	SD	Max.	N	X	SD	Max.	N	X	SD	Max.
		(km)				(km)				(km)		
1	32	1.5	1.1	3.7	24	2.5	1.7	6.9	8	1.8	1.5	4.5
2	27	1.9	1.4	5.0	25	2.7	2.7	11.2	20	4.1	3.8	15.0
3	24	2.1	1.3	4.8	16	2.5	2.1	9.0	9	7.4	4.0	13.1
4	24	2.6	1.6	5.7	20	3.6	2.9	10.3	4	10.9	4.4	17.0
5	16	2.5	1.7	5.5	17	3.3	2.3	6.9	16	7.1	5.3	20.5
6	23	3.5	2.2	8.2	19	3.9	3.0	10.1	14	8.3	7.2	21.2
7	28	2.9	2.1	8.0	29	4.2	2.7	10.1	11	8.1	7.0	26.6
8	19	3.4	2.0	8.0	22	3.6	2.6	10.1	9	6.2	3.6	13.9
9	22	3.3	4.5	7.5	17	3.3	2.7	10.1	7	7.8	2.1	10.9
10	22	4.5	2.8	12.0	23	3.2	2.6	11.3	8	5.4	3.1	9.2

¹Mountain lions F4(11-11-84 to 02-28-85), F5(04-01-85 to 06-30-85), F9 with M11, F7 with F6, M12, M2.

²Mountain lions F3(07-13-83 to 09-27-83), F4(06-22-83 to 06-08-84), F5(06-29-83 to 11-27-84), F9(01-10-85 to 05-19-85).

³Mountain lions M1, M3, M4, M7, M8, and M9.

Most of the mountain lion movements were nocturnal or crepuscular, but several daytime movements were monitored. F5 was monitored moving during the day on several occasions in October 1983. She moved at least 1.8 km (1.1 mi) between 1000 and 1700 hours on October 5th. On October 6th she moved a minimum of 1.3 km (0.8 mi) between 1330 and 1530 hours. F5 and two 2-3 month old kittens were found moving between 1055 and 1300 hours on February 24, 1985. During a light rain on May 18, 1985, F9 moved a minimum of 0.4 km (0.3 mi) between 1500-1520 hours. Two juvenile littermates, F10 and M12, moved 0.6 km (0.4 mi) between 0900-1214 hours on April 23, 1985.



(- - -) Adult Females with 5-12 mo offspring
 (. . .) Adult Females without kittens
 (——) Adult Males



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

MOVEMENT DISTANCES BETWEEN
DAILY RELOCATIONS

File No. 150-03

Date 11-27-85

Figure 28

The actual distances traveled between successive daily relocations may be much greater than the linear distance. Night monitoring of movement by adult females F3, F4, F7, and F9 on 9 occasions showed that the mean distance traveled was 6.6 km (4.1 mi) for bed sites which were only 1.6 km (1.0 mi) apart. Additionally, on two occasions nocturnal movements were monitored for animals which returned to their same bedsites. F7 traveled a minimum of 5.8 km (3.6 mi.) to and from a kill, and F9 traveled a minimum of 1.5 km (0.9 mi) during the night, returning to the her previous bedsite.

The path traveled by a mountain lion was often difficult to determine due to the level of accuracy of the telemetry equipment and methodology. Signal variation often indicated activity but triangulation indicated that the individual was stationary or moving in a localized area. Localized activity of this sort was frequently noted at the initiation of activity and at various intervals during nocturnal movements.

Monitoring of animals during the night offered several opportunities to estimate the rate of travel of mountain lions in the study area. F9 moved 41 m, 38 m, and 41 m (131 ft, 122 ft, 131 ft) per minute, during 3 intervals of 22, 24, and 33 minutes respectively. During one 10 minute interval she traveled 120 m (384 ft) per minute or 7.2 km/hr (4.4 mi/hr).

F9 often bedded down near State Highway 7 which leads to the entrance of Carlsbad Caverns. Sixty-three of 81 locations (78%) obtained on F9 were within 1 km (0.6 mi) of this highway. National Park Service records indicate that approximately 350,000 visitors passed along this highway during the 8 months that F9 was radio-collared. There were 300-1200 vehicle round trips per day during this period, mostly between 0730 and 2100 hours. Sightings and monitoring efforts suggest that F9 frequently travelled short distances on the pavement while moving at night.

Movements Relative to Sheep Predation.

F7 Family Group-- The F7 family group was described in the home range section above, as was the expansion of their home range

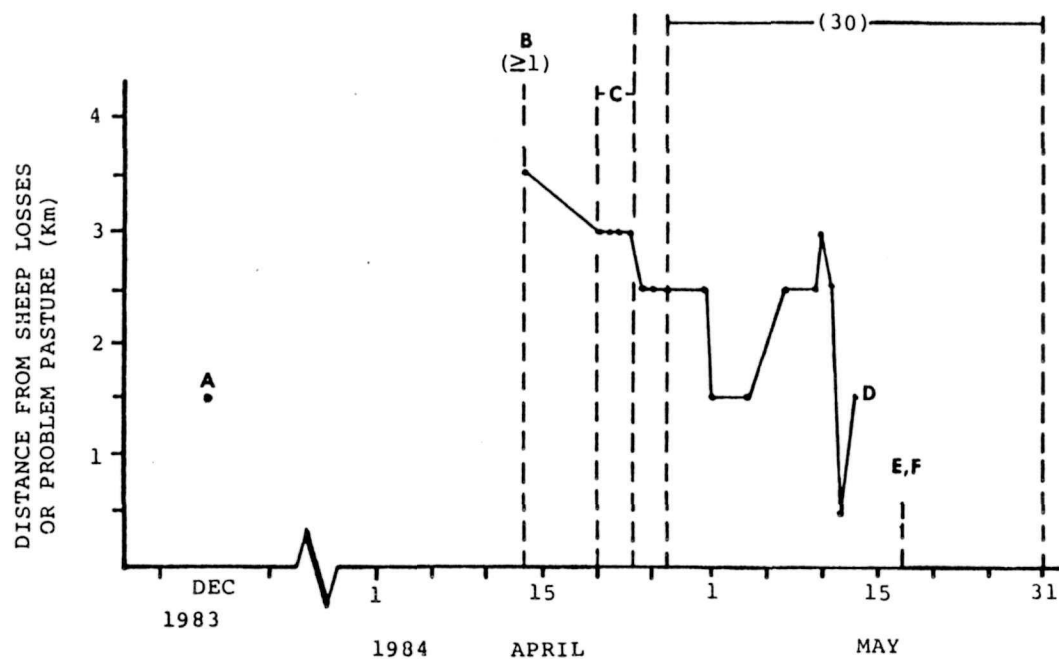
into sheep pasture on Ranch C (Figure 1A) at about the time that the two kittens of the group were 6 months old. Figure 29 shows that the distance of the group's bedsite from the pasture as depredations began was approximately 2.5 km (1.5 mi). Over the next month, as the family group shifted to bedsites out of GUMO and nearer the pasture, 30 sheep were reported killed by lions.

They apparently preyed on sheep with increasing frequency from the date of F7's capture until their death. F7 was killed on May 15th, 1984, and F6 and her littermate were killed 2 days later. The stomachs of both kittens were empty and there were no indications that they continued preying on sheep after F7 was killed. These animals were killed by a predator control specialist of the New Mexico Game and Fish Department, and it was later learned that the specialist had located them by radio-telemetry.

The behavior of mountain lions during an attack on sheep was monitored for F7 and F6 on May 12th. Their bedsite was outside the park and less than 1 km (0.6 mi) east of the sheep range. F6 and F7 were active but relatively stationary at 1938 hours. At 2136 hours F7 began moving west, was seen crossing the entrance road to GUMO four minutes later, and entered the sheep pasture. Her kitten, F6, stayed near the bedsite. After crossing the road, F7 traveled approximately 0.5 km (0.3 mi) west, and apparently killed two sheep. She had left the sheep pasture and rejoined F6 by 2255 hours. Monitoring ceased at approximately 2310.

M2 Family Group-- M2's family group resided in the northwest corner of GUMO from December 1982 until May 1983, as previously presented in both the home range and dispersal sections of the report. Figure 30 illustrates that M2 did not encounter sheep until he began to enlarge his home range prior to dispersal in May, even though he was commonly within 2.5 to 8.5 km of sheep range from late December to early April, 1983. Twelve sheep were killed during the period that M2 and his littermate (Tattoo 03) moved into and through the pasture.

() = NUMBER OF SHEEP LOSSES



- A - Kitten tracks found in GUMO in the region where P7 and P6 were captured in April 1984.
- B - P7 capture, regurgitates sheep remains while recovering from immobilization.
- C - Family group fed from a deer.
- D - P7 shot on May 14th.
- E - P6 and littermate shot May 17th.
- F - Unidentified mountain lion snared 5 km west of P6 on the night of May 16-17. Snare anchor broke, individual was believed to enter GUMO.



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

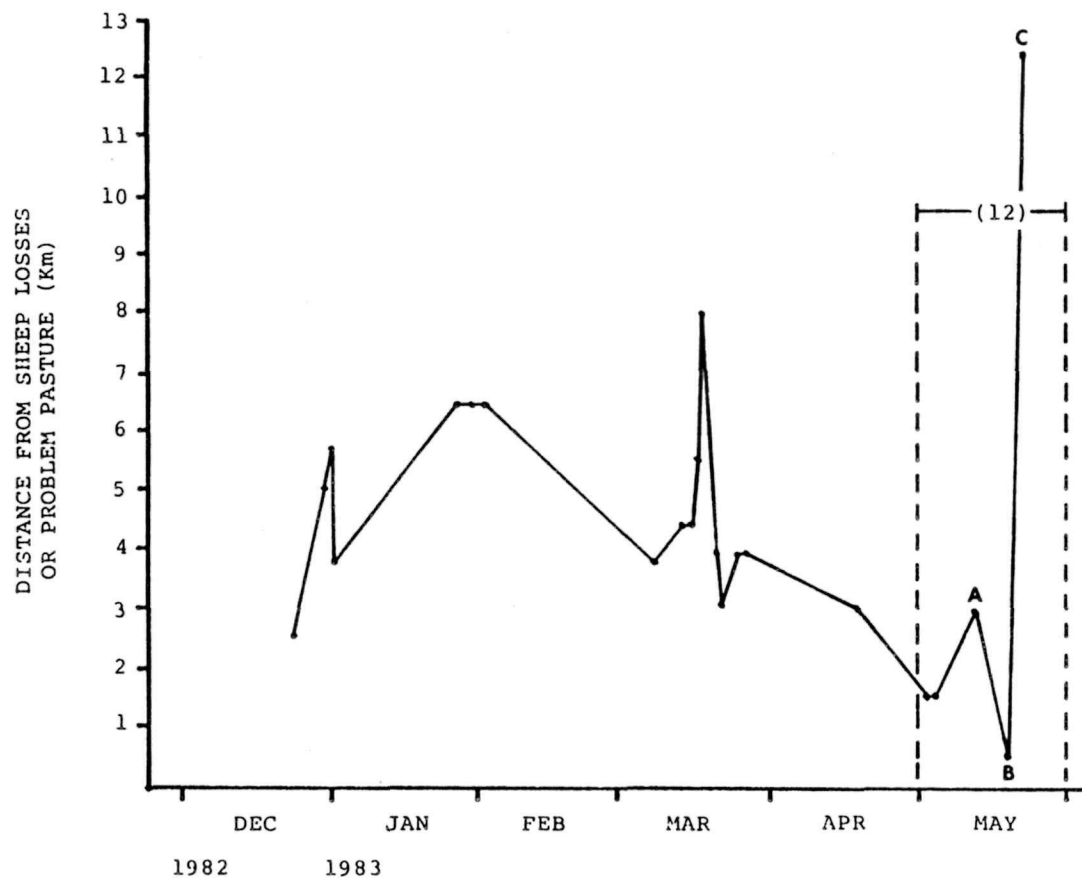
MOVEMENT OF F7 RELATIVE
TO SHEEP LOSSES ON RANCH C

File No 150-03

Date 11-27-85

Figure 29

() = NUMBER OF SHEEP LOSSES



- A - May 12th, M2 bedded down in GUMO; non-instrument female littermate 03 was trapped on the night of May 12-13 in sheep pasture.
- B - Located on Ranch C in close proximity to several recent sheep losses.
- C - Movement made during early phase of dispersal.



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

MOVEMENT OF M2 RELATIVE TO SHEEP LOSSES ON RANCH C

File No. 150-03

Date 11-27-85

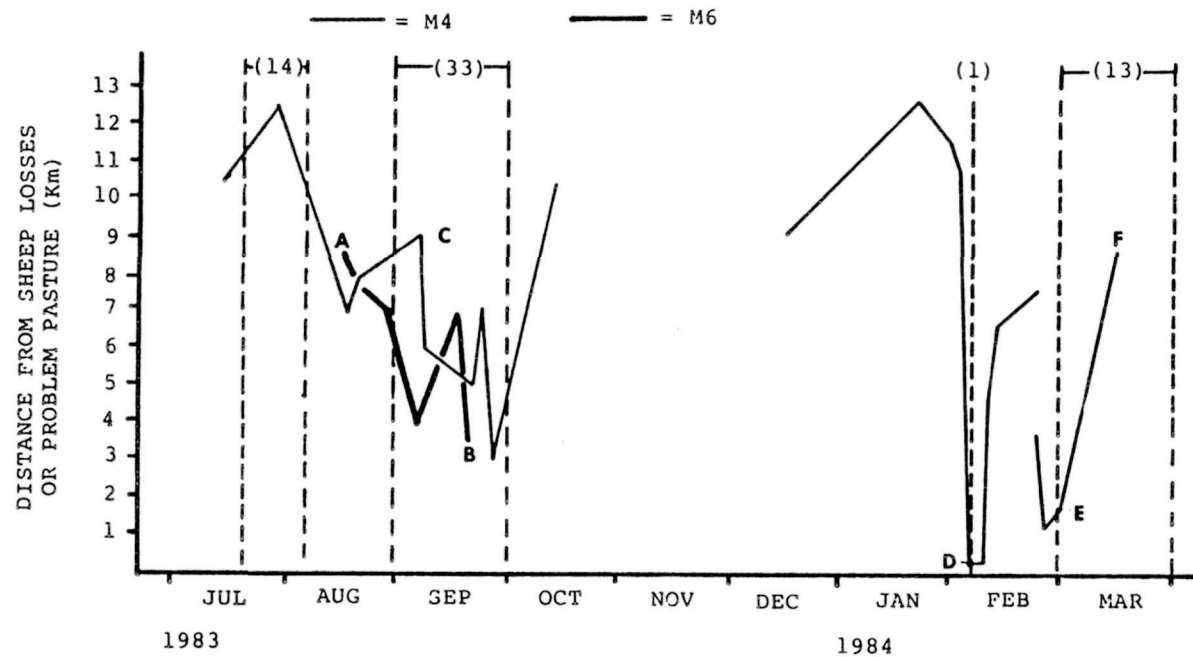
Figure 30

M4 -- M4, a 6-7 year old male, had a home range which centered near the western escarpment of the LNF (Figure 5). This region borders Ranch C where 14 sheep were killed in July and early August 1983. At the time, his bedsites were 10-13 km away (Figure 31), which suggests that M4 was not involved in the depredations. However, during September 1983, 33 sheep were killed at a time when both M4 and M6 were near the pasture. Both animals seem to have been involved. Four months later, in February 1984, M4 killed at least 1 ewe and was also implicated in depredations which began 2 weeks later (Figure 31). M4 was reported killed in late March 1984.

M5 -- M5 was captured with M6 on August 8, 1983 along the northern border of CACA, 18 km (11 mi) west of Ranch A. They were believed to be littermates and were approximately 12 months old when captured. M5 made several wandering movements before gradually moving east (Figure 6). From September 26, 1983 to April 3, 1984, M5 centered his movements in eastern CACA. Figure 32 illustrates his pattern of movement to and from the vicinity of Ranches A and B from January to August 1984. Visits on or near the sheep ranches were often interspersed with distant movements into other areas. Seven occasions were noted when M5 was located for varying lengths of time within 3 km (1.9 mi) of depredations or problem pastures. He is known to have killed sheep on 2 of these occasions and was on or near the pastures during 3 periods of depredations.

M6-- M6 was one of 2 juvenile males captured together on August 8, 1983 along the northern border of CACA (see M5 above). He was apparently dispersing from his natal home range which may have been nearby. Following a relocation 4.1 km west of his capture site on August 10th, M6 was 22 km west of his capture site on August 18th. This placed M6 along the western edge of the LNF at the top of a 300 m (960 ft) escarpment above the eastern border of Ranch C (Figure 7). He was relocated in the same general vicinity during the next 2 days, but on August 30th M6 was located approximately 1 km (0.6 mi) southwest of the previous locations and below the escarpment.

() = NUMBER OF SHEEP LOSSES



- A - Previous location for M6 was 16.8 km east on August 10, 1983.
- B - M6 trapped in sheep pasture on September 20th.
- C - Tracks of an adult male reported on sheep pasture.
- D - Closely associated with a dead ewe killed within 12 hours of radio-location.
- E - Track of an adult male reportedly associated with lion-killed sheep.
- F - Last location obtained on M4.



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

MOVEMENT OF M4 AND M6 RELATIVE
TO SHEEP LOSSES ON RANCH C

File No 150-03

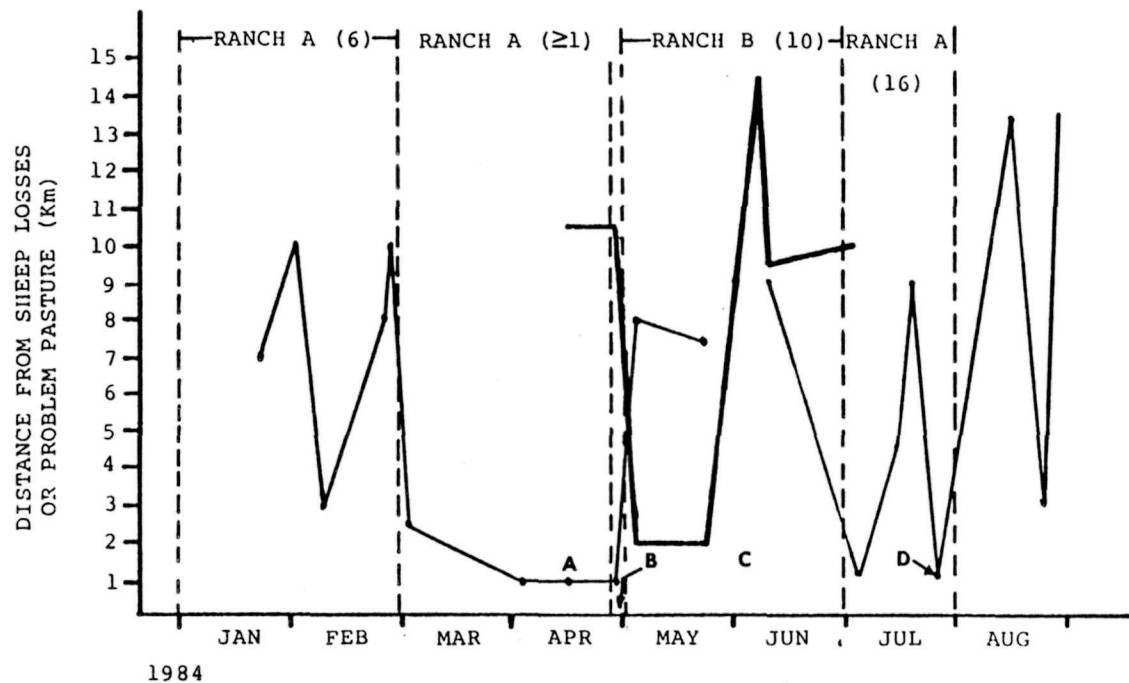
Date 11-27-85

Figure 31

() = NUMBER OF SHEEP LOSSES

 = RANCH A

— = RANCH B



- A - Snare wound indicates M5's presence in sheep pasture in late March or early April.
- B - Fresh scat containing sheep remains collected without report of depredation.
- C - M8 on or near Ranch B, family group believed responsible for losses.
- D - Closely associated with a minimum of 3 dead sheep killed within 12 hours of radio-location.



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

MOVEMENT OF M5 RELATIVE
TO SHEEP LOSSES ON RANCH A AND B

File No 150-03

Date 11-27-85

Figure 32

Figure 31 illustrates M6's pattern of movement relative to the temporal distribution of sheep losses. All available evidence indicates that M6 began preying on sheep at this time. A young male mountain lion was trailed on September 18 from sheep killed during the night, but the scent was lost as the hounds trailed east, along a line that would have led them to M6's bedsite. During the night of September 20th M6 was trapped and killed in a sheep pasture less than 1 km (0.6 mi) from the northern boundary of GUMO. The carcass and digestive tract were not made available for analysis.

Movements and Activity Relative to a Kill

The movement and activity of mountain lions relative to deer kills were recorded in detail on two separate occasions. In the first instance, F7 killed a yearling male deer 2.3 km (1.4 mi) from her diurnal bedsite. She fed on the deer with her kitten, F7 and probably with the other littermate. They left the kill by 0600 the next morning, and moved to a new bed site closer to the kill. This site was 0.4 km (0.2 mi) from their previous bedsite and 1.8 km (1.1 mi) from the kill. They returned to the kill for the next three days. They began to move toward the kill at about 45 minutes after sunset each evening after a short period of localized activity. They arrived at the kill approximately 1.5 hours after sunset traveling an average distance of 1.8 km (1.1 mi). At approximately 300m (960 ft) from the kill F7 appeared to lead the way with F6 about 3 minutes behind. They stayed at the kill or in the immediate vicinity until approximately 1 hour before dawn on nights 2 and 3 but left the kill at approximately 0230 hrs on the last night of feeding.

The other closely watched kill was a deer apparently killed on November 13, 1984 by M12's mother (see family groups above). Tracks at the carcass suggested that M12's entire family group fed from the kill. The next day, the group had moved away from the kill and M8, an adult male, had apparently moved in. M8 was located on November 14th 0.8 km (0.5 mi) SSE from this kill and M12 was 4.8 km (3.0 mi) SSW of the kill. The following day, November 15th, M12 was located 7.2 km (4.5 mi) SSW of the kill

and M8 was 1.0 km (0.6 mi) SSE of the kill. The deer had been fed from during the night and when dogs were started from the kill the fresh trail led directly to M8. M12's family group either abandoned the kill, or M8 pirated the deer from the family group.

ACTIVITY

Activity was usually initiated within about 20 minutes of sunset and was characterized by a 5-30 minute period of activity prior to movement. Observations of F3 and F9 showed that both animals were active at their bed sites after waking up. They then both walked approximately 70-90m (225-300 ft) from their bed sites to prominences and gazed from side to side.

Activity during the day was recorded for both adult female F9 and juvenile male M12 from motion sensitive radio-collars. F9 was active both in the morning and the afternoon. M12, however, seemed to be more active in the morning than in the afternoon.

Few data were gathered regarding cessation of activity but on 4 or 5 occasions, activity apparently ceased within 1 or 2 hours of sunrise. F6 and possibly her mother (F7) and littermate, ceased moving and appeared to bed down for the day 2 hours after sunrise on April 13, 1984. On April 21-24, 1984 F7 and F6 apparently left their kill well before sunrise and had bedded down by sunrise. On July 13, 1983 F3 was still moving 1.5 hours after sunrise and bedded down approximately 30 minutes later. On July 14, 1983 F3 ceased movement approximately 45 minutes after sunrise but was active for at least 30 additional minutes. On March 8, 1985 F4 appeared stationary at 0721 hours, 63 minutes after sunrise, but moved again between 0915 and 1020 hours. On June 5, 1985 F9 bedded down 0.5km from her kittens between 0715 and 0839 but rejoined them by 1022.

MORTALITY

Sixty five mountain lions were killed in the study area from September 23, 1982 to June 25, 1985. Twenty one of these lions were killed in field year 1982-83, 25 were killed in 1983-84, and 19 were killed in 1984-85 (Figure 33). The approximate or actual location of the mortalities were recorded. Areas where mortalities were clumped were then mapped (Figure 34). Eighty five percent (55) of the 65 mortalities recorded occurred within 3 regions comprising approximately 260 km² (100 mi²) or 25 % of study area (Figure 34). Most of these mountain lions were killed with the aid of dogs, steel traps, or neck snares (Table 5).

Table 5. Method of take for 65 mountain lion mortalities in the Guadalupe Mountains of New Mexico, September 1982 - June 25, 1985.

Aid of Dogs	Steel Traps	Neck Snares	Foot Snares	Opp. ¹	Unknown ²	Capture ³	Natural ⁴
29	16	7	1	6	4	1	1

¹Opportunistic, shot on sight without the aid of traps or dogs.

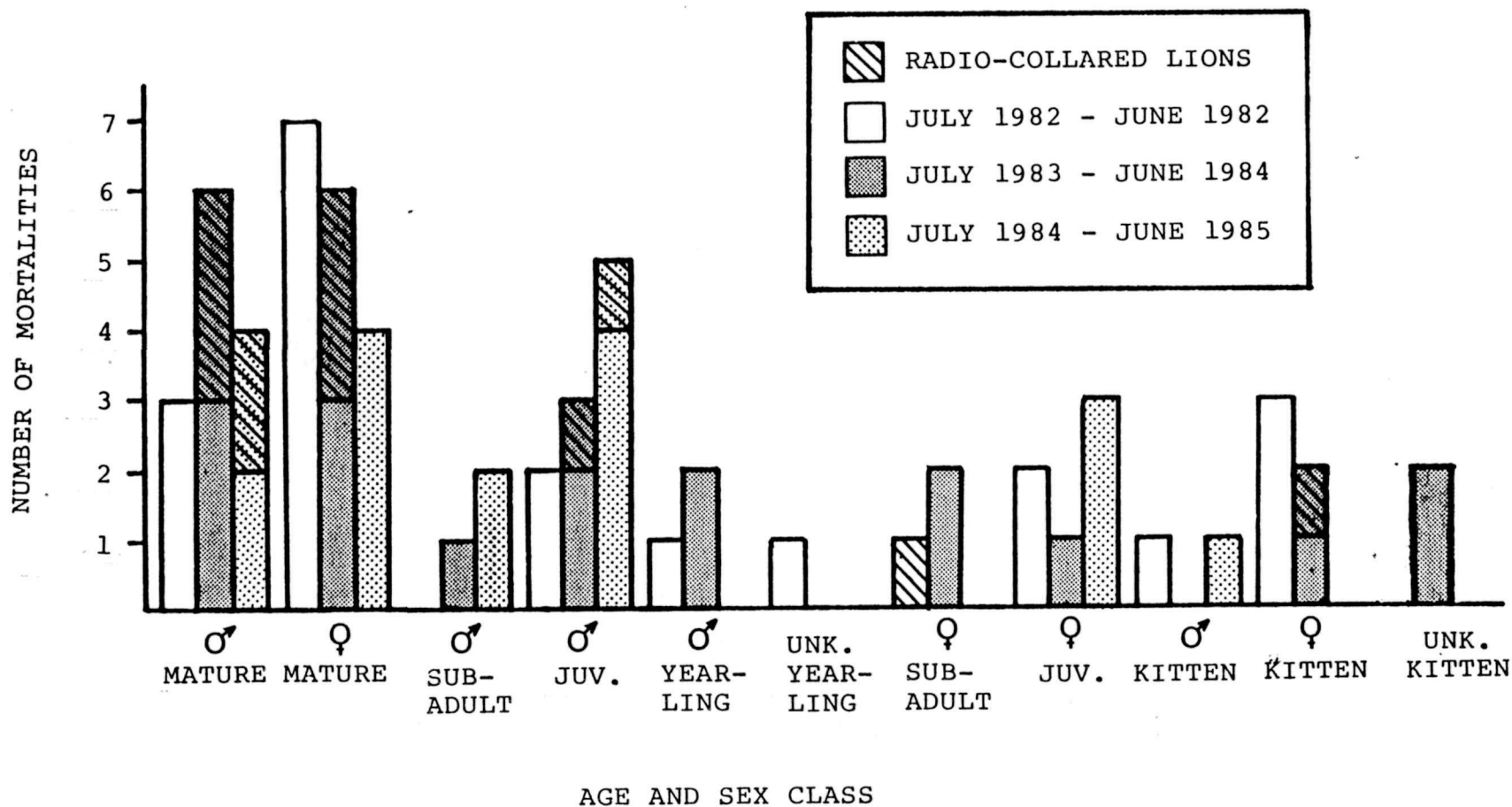
²Not a natural or capture related mortality.

³Died from a fall during capture and restraint procedure.

⁴Cause of death not determined.

Comparison between mortalities recorded during this study, and those reported to the New Mexico Department of Game and Fish indicates that 14% (9) of the 65 mountain lion mortalities were not reported to state authorities.

Only 6 of the 22 radio-collared mountain lions were being monitored at the conclusion of field efforts on June 30, 1985 (F4, F5, F9, F10, M7, and M12, see Figure 1B). Contact was lost with 3, and 13 are known or believed to be dead (Table 6).



* An additional radio-collared mountain lion was killed outside the study area



HARVEY AND STANLEY ASSOCIATES, INC.

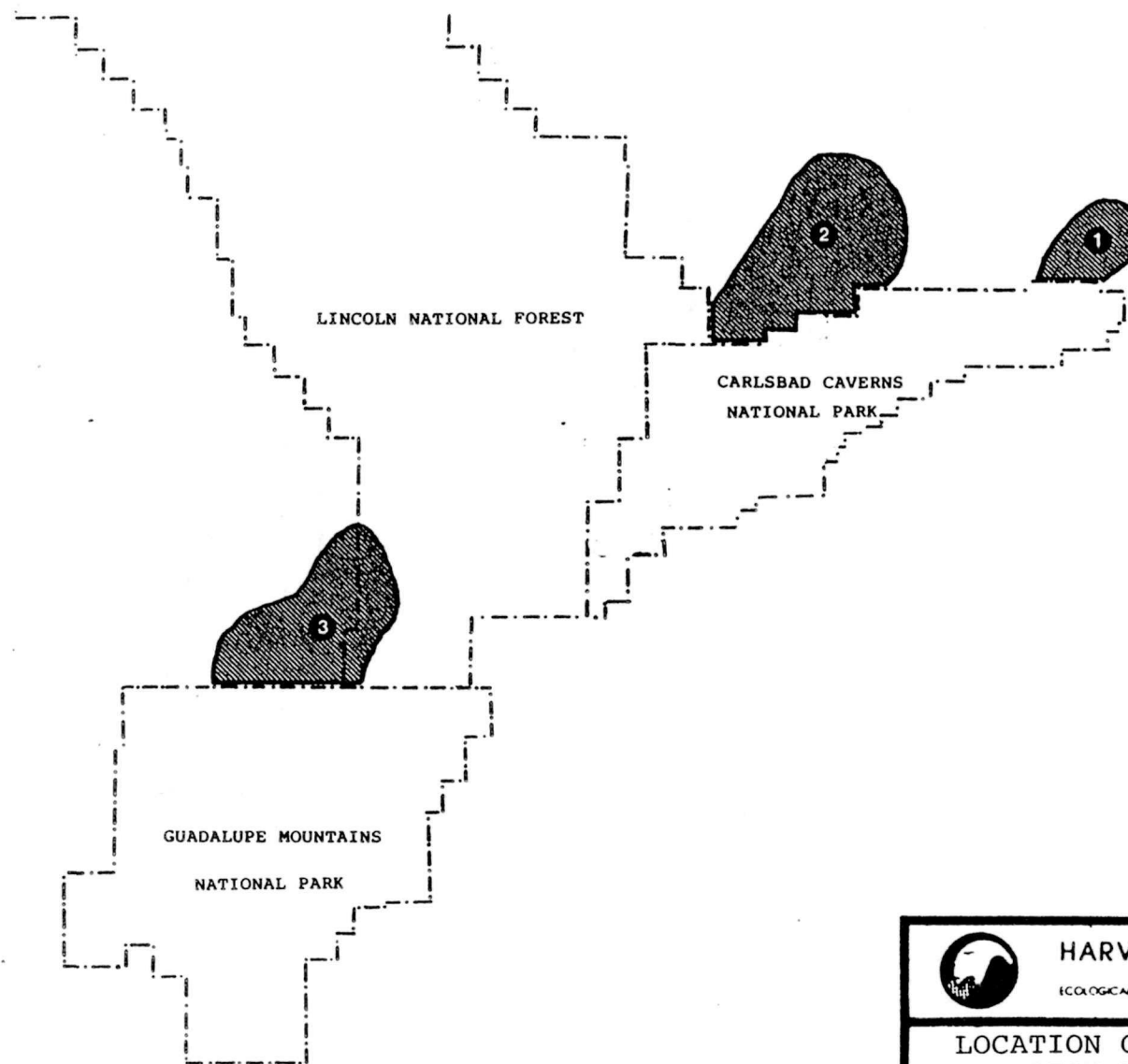
ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

AGE & SEX STRUCTURE OF LIONS KILLED

File No 150-03

Date 11-27-85

Figure 33



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

**LOCATION OF AREAS OF HIGH MOUNTAIN
LION MORTALITY: 6/82-7/85**

File No 150-03

Date 11-27-85

Figure 34

National Park Service employees indicated that F10 was killed near Van Horn Texas after the conclusion of field efforts during this study.

Table 6. Cause of death and method of take for 13 radio-collared mountain lions in the Guadalupe Mountains of New Mexico and Texas, between March 1983 and January 1985.

	Trapped or Snared	With Aid of Hounds	Unknown	Total
¹ State or Private Control	6 ²	2 ³	-	8
⁴ Justification Unknown	-	1	3	4 ⁵
Possibly Study Related	-	-	1 ⁶	1

1. Includes mountain lions killed in snares set by unidentified persons. Deaths or snare locations not reported to state authorities (M2,M9,F3).
2. F1, F3, M2, M3, M6 and M9.
3. F6 and F7
4. Unreported sport hunting or predator control. Based on reliable, confidential reports or circumstantial evidence.
5. M1, M4, M5 and M11.
6. F8.

A summary for each of the dead or missing radio-collared lions follows:

Dead radio-collared lions

M1-- Captured in September of 1982, M1 occupied the study area through July of 1983. The last location (type 3) of M1 suggested that he traveled further east than indicated by his home range polygon. This last relocation together with the northeastern

relocations in M1's home range suggest that M1 occupied or was often in close proximity to, mortality region 2 (Figure 34). A report from a reliable source indicates that M1 was killed in mortality region 2 with the aid of hounds in August 1983.

M2-- Radio-collared as a kitten in December of 1982, M2 dispersed 48 km (30.0 mi) north of his juvenile home range in May 1983. After leaving the study area, M2 was monitored from the air until November when a series of clumped locations suggested he might be dead. The radio-collar and portions of his skeleton were found near a reset snare which had recently captured a lion. The condition of M2's remains and the relocation data suggest that he died in August 1983.

M3-- Radio-collared in July 1983, M3 occupied a home range that covered a large portion of GUMO. He was trapped in Region 3 (Figure 34) during February 1984, but evidence suggests that he was not preying on sheep at the time. His stomach was empty when he was killed and 2 relocations obtained 8 and 5 days prior to his death were from areas outside sheep range. Though he was killed within several kilometers of occupied sheep range, M3 did not appear to use that area as part of his home range.

M4-- Captured in GUMO in July 1983, M4 moved north across the state line soon after capture. M4 was monitored until March 1984 when contact was lost. M4's home range encompassed region 3 (Figure 34) and his presence in or around that area was known by several area houndsmen and ranchers. M4 preyed on sheep on at least one occasion. M4 is believed to have been killed within his home range in March 1984.

M5-- M5's home range encompassed portions of CACA and of Ranches A and B (Figures 1A and 6). M5 killed sheep on at least 2 occasions. During a routine recapture in April 1984, a neck snare was found around the waist of M5. The wire had entered the peritoneal cavity and had cut deeply into the back and sides. The wound was sutured and an antibiotic was administered. M5 probably would have died as a result of the snare had it not been removed. M5 appeared to have recovered from his wound as evidenced by his movement pattern through September 12, 1984 when

radio contact was lost. He is believed to have been killed near his last location in the latter half of September 1984.

M6-- Captured along the northern border of CACA in August 1983, M6 soon dispersed 22 km (13.8 miles) westward, eventually centering his activity around sheep range north of GUMO. He was trapped in region 3 (Figure 34), approximately 1 month after arriving in that area and was believed to have been killing sheep.

M9-- Radio-collared in April 1984, M9 died in a snare in region 2 (Figure 34) near the border of CACA in July 1984. The snare was apparently set and not inspected regularly, a violation of New Mexico Game and Fish regulations. What little was known of his home range did not encompass sheep range. M9 used the northeastern portion of M1's home range that was vacated when M1 died approximately 7 months earlier.

M11-- Contact was lost with F9's juvenile offspring M11 in early January 1985 in mortality region 2 (Figure 34). Subsequent tracking efforts of F9 in snow during January failed to reveal sign of M11. The last location obtained on M11 was the first significant movement recorded off National Park property and the first time in that region (Figure 12). M11 was 7-9 months of age at the time of his disappearance and was probably too young to have dispersed. As a result, M11 is believed to have been killed in early January 1985.

F1-- Captured in December 1982, F1 occupied a home range encompassing GUMO, LNF, and private rangeland. A subadult female, F1 is believed to have been a recent arrival to the area described by her home range. Radio-collared for three months prior to her death, F1 used a relatively small area and did not exhibit movements suggestive of dispersal or transiency. Tracks found in the region prior to, and after her capture indicated that she was traveling alone. F1 was trapped in region 3 (Figure 34) near the north boundary of GUMO in March 1983. While closely bordering occupied sheep range F1 was never implicated in any sheep depredations during the months that she was radio-collared. Her stomach contained porcupine remains at the time of death.

F3-- Captured on February 7, 1983, F3 occupied a 39 km² (15 mi²) home range inside CACA. F3 was killed in a neck snare on the north boundary of CACA in region 2 (Figure 34) in late November 1983.

F7 and F6-- Captured in GUMO during late March 1984, F6 was 1 of 2 female kittens. The mother of these kittens, F7, was captured in GUMO during April 1984. Tracks of this family group were first discovered in GUMO during December 1983. F7 was first known to prey on sheep in April 1984. During this time the family group continued to reside in the park until May when they shifted their bedding location north of the GUMO boundary. At this point they appeared to prey exclusively on sheep with nightly forays into occupied sheep range. F7, F6, and another female kitten, were shot in region 3 (Figure 34) by a state predator control specialist in May 1984.

F8-- Captured on May 18, 1984 F8 moved 2.6 km (1.6 mi) from the location of her capture to a rugged section of canyon bottom. In June an effort was made to determine her reproductive status. During this effort she was found dead, apparently having died shortly after capture. The cause of death is unknown, but due to the short span of time between her capture and death, the possibility that it was capture related cannot be ruled out. At the time of her capture, lion scats containing calf hair were found in the vicinity, and the remains of a lion-killed calf were found later in June. It is possible that F8 may have killed at least 1 calf prior to her capture.

Lions whose fate is unknown

F2--Contact was lost with F2 in May 1983 but an additional location was obtained in July 1983 on Ranch B (Figures 1A, 15). It is believed that F2 was either killed or her transmitter malfunctioned.

M8--M8 shifted his home range from the eastern portion of his range to the western portion beginning in October 1984. He

centered his movements in this region until contact was lost in late December 1984. Tracks of an adult male were found in the western portion of his home range in April 1985.

M10--Contact was lost with M10 in March 1985 south of the study area. His movements suggest that he was a transient male. M10 may have moved further south into the various small mountain ranges in west Texas.

REPRODUCTION

Natality

Three prenatal litters were noted from the study area. Shortly before the start of this study 2 pregnant females were taken, with 3 and 4 fetuses reported in utero. Another female taken in May 1983 contained 3 fetuses with 2 corpora lutea on each ovary. One of these fetal kittens appeared to have died in utero.

Three postnatal litters were discovered within 3 months of birth all consisted of 2 kittens. Two of these were found within 2 weeks of birth.

Five postnatal litters with 5-7 month old kittens were discovered. Litter size for these 5 were 1 (N=1), 2 (N=3), and 3 (N=1) averaging 2.0 kittens per litter. Unsubstantiated reports of litters with as many as 5 kittens were received.

Approximate dates of birth were estimated from 11 litters ranging in age from 1 week to 7 months and from 1 prenatal litter. Six were born between May 1st and July 31st, 2 in August or September, and 2 between October and November. An unconfirmed report was received of kittens born in March or April. An adult female killed on April 14, 1985 had swollen uteri with a developed endometrium suggestive of estrus or early pregnancy.

Female Reproductive Behavior

On February 26, 1985 F9 was monitored as she moved from a bed site 0.2 km (0.1 mi) from the highway. Caterwauling similar to that described by Rabb (1959) was noted as she initiated activity at 1740. Between this time and 2345 hours 10 similar incidents were recorded totaling at least 500 vocalizations. She traveled a minimum of 5.0 km (3.1 mi) during this time, stopping when she caterwauled. She traveled at least 6.7 km (4.1 mi) on February 27th between 1705 and 2215 hours but no vocalizations were noted. On February 28th, F9 was monitored between 1705 and 1945 hours before her signal was lost and vocalizations were noted at 1800 and 1850. Movement was initiated at 1805. She moved a minimum distance of 1.2 km (0.75 mi) between 1805 and 1945. F9 gave birth to 2 female kittens in late May, 1985 which indicates that F9 was probably in estrus when she was recorded caterwauling.

DENSITY

There were 75 mountain lions identified in the study area either through radio-collaring or death between June 1982 and July 1985. Fifty-three non-radio-collared lions were killed, 13 radio-collared lions were killed (including one killed outside the study area), 3 collared lions are missing, and 6 collared lions were alive in the study area at the conclusion of field work on June 30, 1985. This figure is intended only as a general measure of mountain lion abundance and is not a density estimate due to the length of time (36 months) during which these lions were identified.

The maximum density for the study period has been calculated based on known occurrences. The greatest adult density known for 259 km² (100 mi²) occurred in July and August 1983 when 4 adult females and 2 adult males inhabited the northern portion of GUMO and the southern reaches of LNF. Two of the females were F7 and F5, a third was the mother of M2 as discussed earlier. Sign of another lion, probably female, was found on the east escarpment of GUMO in June 1983. She was probably present during July and August as well. The 2 adult males occupying this region were M3

and M4. M4 did not remain in this region long, but soon moved north.

Similarly, four adult females and 2 adult males were present in the CACA region in November and December 1982. An adult male, adult female and female kitten were killed on November 13, 14, and 15, respectively. Another adult male was killed on or about December 17th, 2 km (1.2 mi) north of CACA. F2 and F3, captured on January 16th and February 7, 1983, were each accompanied by at least 1 4-5 month old kitten. The presence of kittens indicates that they were residents during November and December 1982. The presence of a fourth adult female is inferred by the presence of 3 kittens killed during February 1983.

Three adult females and 1 adult male occurred within a 10 km² (4 mi²) vicinity of eastern CACA and Ranch A in late March and April 1983. On March 26th, an adult female was killed within 2 km (1.2 mi) of the northern boundary of CACA. On April 13th and 17th an adult female and an adult male, respectively, were killed in the same area. The home range of F9 during this time was within 2 km of all 3 mortalities. The presence of the male and at least 1 of the females had been noted in the area at least 2 weeks prior to their deaths. F9 bred in late February 1985. An adult female was killed on February 4, 1985 within 12 km (7.5 mi) of the location of the 3 mortalities and within 4 km (2.5 mi) of tracks and scrapes found in March attributed to the male. These data suggest that a minimum of 4 females and 1 male were present within a 259 km² (100 mi²) area in February and March 1985.

The greatest yearling density occurred in December 1983 and January 1984, when 3 individuals of this age class occurred in 259 km² (100 mi²). In December 1983 two juvenile males were killed 7 km (4.3 mi) apart and within 5 km (3.0 mi) of the northern boundary of GUMO. In January 1984 a juvenile female was killed 8 km (5.0 mi) north of GUMO. The relatively short distance between the locations where each male was killed suggests that they may have been littermates.

These densities would extrapolate to 24 mature adult and 12 yearling lions or a maximum estimate of 36 yearling and adult lions for the study area of 1036 km² (400 mi²).

If 4 adult females per 259 km² (100 mi²) is the adult female density then 16 adult females could be expected to occupy the study area. With an average of 2.8 kittens per female at birth (Anderson 1983) and if half of the adult females give birth in a given year (Hempker et al. 1984) then 22 kittens may conceivably be produced on the study area annually.

Using the above estimates for adults, yearlings, and kittens the maximum population size for the study area would be 58 lions. A recently used standard expression of density for mountain lions relates the density per 100 km². On this basis densities for this study are 2.3 adults per 100km², and 5.6 total mountain lions (all age classes) per 100km².

SCRAPE SITES

Between July 1, 1982 and July 30, 1984, 409 scrapes were recorded at 249 sites, averaging 1.6 scrapes per site. Approximately 69 percent of these sites were located in GUMO, 22 percent in the LNF and 9 percent in CACA. Scrape site monitoring efforts were discontinued during the third year due to a shortage of personnel and high waters in August 1984 which removed many of the sites located in canyon bottoms. Fewer scrapes occurred in the less forested regions of the study area (Table 7). Though effort was not quantified, intensive tracking efforts in CACA during 1985 revealed only 4 scrapes in an 21 km² (8 mi²) area. The effort is believed adequate for determining general trends in scrape site distribution.

The topographic distribution of scrape sites suggests that scrapes were more common on ridgelines in GUMO than in CACA (Table 8). The reduced number and restricted distribution of scrapes in the predominantly desert scrub habitat of the CACA area is probably related to the fact that deciduous shrub and

tree species are distributed primarily in canyon bottoms, and litter is more common in these areas.

Scrapes were usually made in a substrate of leaf litter or decayed vegetation and were rarely found in soil lacking a high percentage of organic content. Scrape site reuse was greatest in GUMO (Table 7). Patterns of regular reuse of scrape sites over the course of a year were not observed. When reuse was noted it appeared to be temporary, or characterized by long periods of time between reuse. Three scrapes sites known to have been used by M9 were reused by M8 3 months after M9's death as M8 moved into M9's home range.

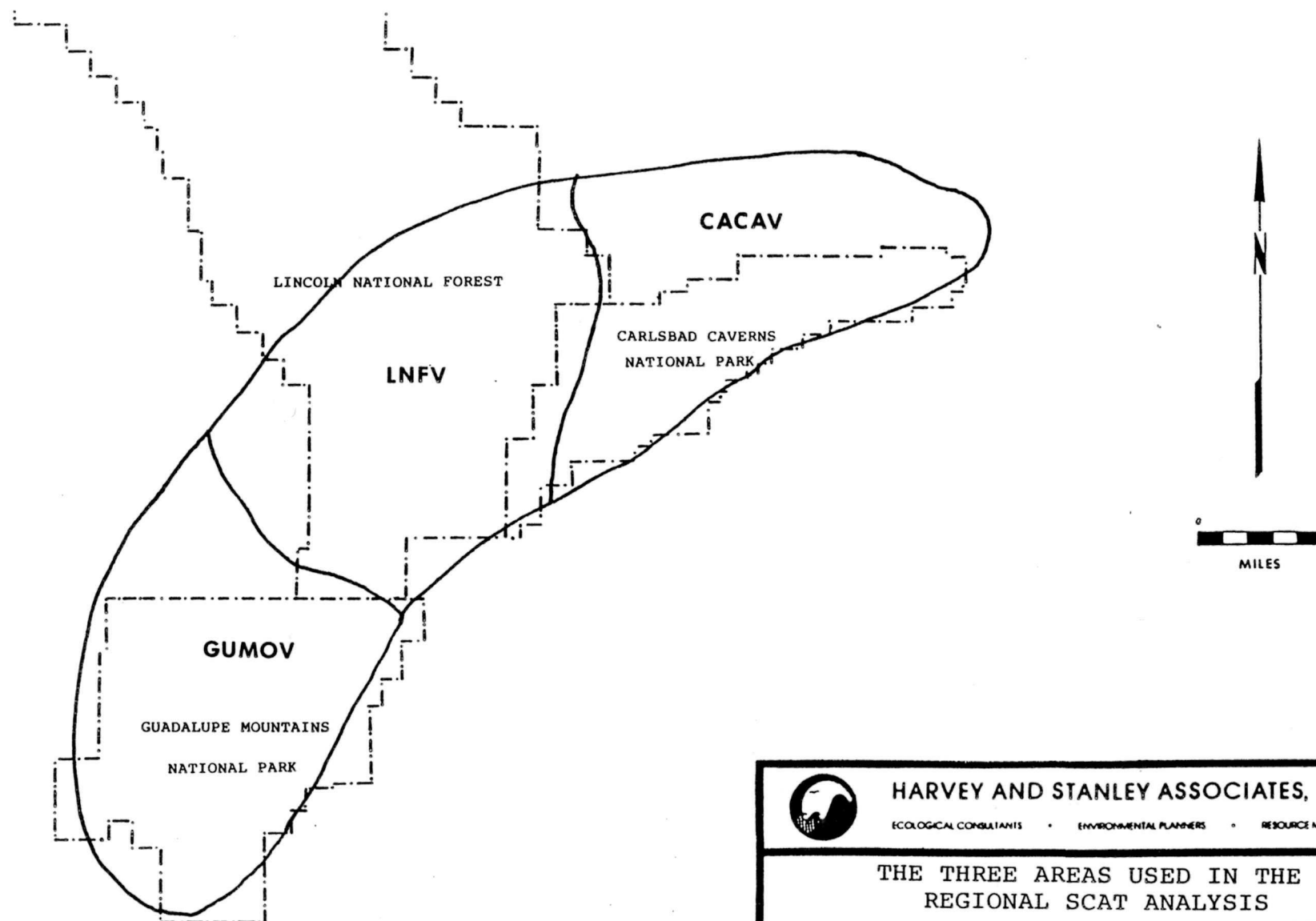
Table 7. A regional analysis of 249 scrape sites reinspected and reused between July 1982 and July 1984 in the Guadalupe Mountains.

Region	Scrape sites	Reinspected ¹		Reused ²	
	N	N	%	N	%
GUMOV*	173	45	26	22	58
CACAV*	22	9	41	3	33
LNF	54	32	59	11	34
Total	249	79	31	36	46

*National Park and Vicinity (Figure 35)

¹Reinspected at a minimum of 90 days after discovery.

²Number reused of those reinspected



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

**THE THREE AREAS USED IN THE
REGIONAL SCAT ANALYSIS**

File No 150-03

Date 11-27-85

Figure 35

Table 8. Topographical analysis of scrape site distribution for each major region of the study area in the Guadalupe Mountains.

Topographic category	GUMO*		CACA*		LNF	
	N	%	N	%	N	%
Canyon bottom	66	38	15	68	36	67
Ridgeline	96	55	5	23	18	33
Mid-slope	9	5	2	9	0	0
Valley Floor	2	1	0	0	0	0
Total	173		22		54	

*National Park and Vicinity

These data suggest that scrape site monitoring might be a more feasible census method in GUMO with transects set up along major ridgelines. In CACA and LNF scrape site monitoring would be most effective in canyon bottoms where litter is more abundant.

FOOD HABITS

Kill Analysis

The remains of 22 lion-killed deer, 2 elk, 1 jackrabbit, 1 calf, and 1 aoudad were found during the course of field work (Table 9). Young (less than 2 yrs.) and old deer (≥ 10 yrs.) comprised 61 percent of the deer kills. Forty-one percent (9) of all deer killed were fawns. The sex ratio among lion-killed deer was not significantly different at 1.2 females for every male. A visual inspection of marrow fat samples was made with fresh kills. Virtually all exhibited white, solid marrow indicative of higher levels of marrow fat.

Table 9. Season killed, species, age, and sex of mountain lion kills discovered August 1982 to July 1984.

Season	Species	Sex	Age of Prey (years)
Summer	deer	Male	1.0
	deer	Female	10.0
	deer	Male	1.0
	deer	Female	1.8
	aoudad	Male	2.0
Fall	deer	Female	10.1
	elk	--	0.3
	deer	Female	10.0
	deer	--	0.5
	deer	--	--
	deer	--	0.3
	deer	--	0.3
	deer	--	0.3
	deer	--	0.3
Winter	jackrabbit ¹	--	--
	elk ²	Female	13.0
	deer	Female	2.5
	deer	Male	2.4
	deer	--	0.5
Spring	deer	Female	--
	deer	Female	--
	deer	Male	1.8
	deer	Male	2.6
	cattle	--	0.3
Unknown	deer	Male	2.0
	deer	Female	1.0
	deer	Female	--

¹Killed by M2 and/or littermate at the age of 6 months.

²Fed on by M2 the night before his capture. The elk was killed at least 2 weeks earlier by a mountain lion.

In addition to the species listed in Table 9, area houndsmen reported a turkey and a skunk killed by mountain lions.

Scat Analysis

A total of 361 scats were collected during the course of the study. Thirty-seven of these samples were discarded due to their proximity and similarity of content to other samples. Six additional samples were discarded due to the lack of identifiable contents (3), small diameter (2), and mis-identification (probable bear - 1).

The results of the scat analysis were tabulated on an annual (all samples) and regional basis (Figure 35), and by scrape and non-scrape association (Tables 10, 11, and 12 respectively). Twenty-two stomachs and 21 intestines were obtained from 25 mortalities, and 2 regurgitations were obtained from radio-collared lions at capture (Table 13).

Table 10. Analysis of 318 mountain lion scats from the Guadalupe Mountains of New Mexico and Texas, 1982-1985.

Scat Contents	Number of Scats	Frequency of Occurrence (%)
Prey Item		
Deer	262 ¹	82
Fawn ²	(88)	(34)
Adult	(176)	(67)
Porcupine	49	15
Lagomorph ³	21	7
Sheep	18	6
Cattle	6	2
Goat	3	1
Rodent	9	3
Raccoon	2	Tr
Gray Fox	2	Tr
Aoudad	1	Tr
Elk	1	Tr
Non-Prey Items		
Felidae ⁴	131	42
Grass ⁵	8	3
Extraneous Materials ⁶	8	3
Vegetation ⁷	230	73

¹Two scats contained the remains of both fawn and older deer.

²At or before birth to approximately 12 months of age.

³Rabbits (*Sylvilagus* spp.) and Hares (*Lepus* spp.).

⁴Self-ingested hair.

⁵Quantities suggested deliberate ingestion.

⁶Rock, sand, and gravel.

⁷Plant fragments, bark, and twigs present in small quantities suggestive of accidental ingestion.

Table 11. A regional analysis of 318 mountain lion scats from the Guadalupe Mountains of New Mexico and Texas, 1982-1985.

Prey Items	CACAV ¹		LNFV ¹		GUMOV ¹	
	N=91		N=103		N=124	
	No.	%	No.	%	No.	%
Deer	75	82	74	72	113 ²	91
Fawn ³	(18)	(24)	(29)	(39)	(41)	(36)
Adult	(57)	(76)	(45)	(61)	(74)	(65)
Porcupine	16	18	25	24	7	6
Lagomorph	4	4	9	9	8	6
Sheep	12	13	1	Tr	5	4
Rodent	2	2	4	4	2	2
Cattle	-	-	5	5	1	Tr
Goat	-	-	2	2	1	Tr
Raccoon	1	1	1	Tr	-	-
Gray Fox	1	1	-	-	1	Tr
Aoudad	1	1	-	-	-	-
Elk	-	-	-	-	1	Tr
Total	112	100	121	100	139	100

¹Regions defined in Figure 35.

²Two scats contained the remains of both fawn and older deer.

³At or before birth to approximately 12 months of age.

Table 12. Analysis of 281 scrape and non-scrape associated scats¹ from the Guadalupe Mountains of New Mexico and Texas, 1982-1985.

Prey Item	Scrape N=141		Non-scrape N=140	
	No.	%	No.	%
Deer	110	78	121 ²	88
Fawn ³	(33)	30	(41)	34
Adult	(77)	70	(82)	68
Porcupine	22	16	22	16
Lagomorph	8	6	9	7
Sheep	7	5	8	6
Rodent	4	3	3	2
Cattle	5	4	1	Tr
Goat	1	Tr	2	Tr
Gray Fox	-	-	1	Tr
Aoudad	1	Tr	-	-
Elk	-	-	1	Tr
Total	158	100	168	100

¹Scrapes are markings made primarily by male mountain lions.

²Two scats contained the remains of both fawn and older deer.

³At or before birth to approximately 12 months of age.

Table 13. Analysis of 22 stomach samples, 2 regurgitations, and 21 intestines from 23 mountain lions in the Guadalupe Mountains of New Mexico, 1982-1985.

Contents	Intestines		Stomachs ²	
	No.	%	No.	%
Prey Items				
Deer	6	29	3	14
Porcupine	6	29	3	14
Sheep	4	19	4	18
Lagomorph	3	14	-	-
Elk	-	-	1	5
Non-Prey Items				
Vegetation	2	10	7	32
Empty ¹	2	10	12	55

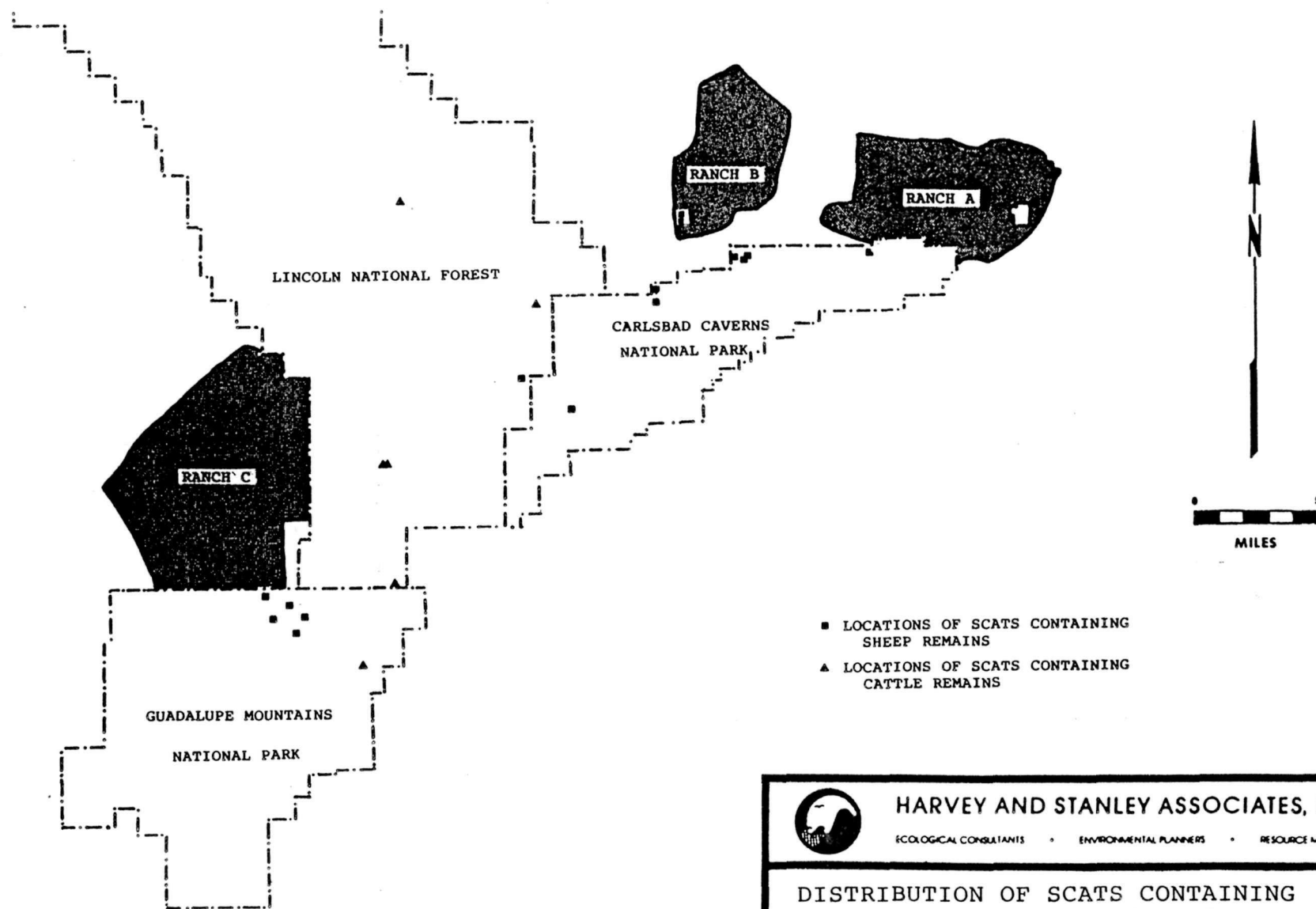
¹Lacking prey remains but may contain trap site vegetation.

²Includes regurgitation

DEPREDACTIONS

Cattle and sheep were both grazed in the study area and both were preyed on by mountain lions during this study. The scat analysis revealed sheep remains in 6% of all scats collected. Cattle remains were found in 2%. Goat remains were also recorded in scats, probably from a small band of feral goats north of GUMO. Figure 36 illustrates the locations where scats containing cattle and sheep were found.

Three calves were reported killed in the LNF during in 1982-83 and at least 2 calves were killed in Spring 1984. A mountain lion was killed in December 1984 after being trailed from a calf reported to show signs of lion predation. North of CACA 4 calves were reported lost from Ranch B in 1984-85. These reports, taken collectively with locations of scats containing cattle hair from Figure 36, indicate that cattle losses occur on most non-park



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

DISTRIBUTION OF SCATS CONTAINING
CALF AND SHEEP REMAINS

File No 150-03

Date 11-27-85

Figure 36

lands within the study area. All reported incidents involved calves. While cattle losses are widespread they have been relatively uncommon.

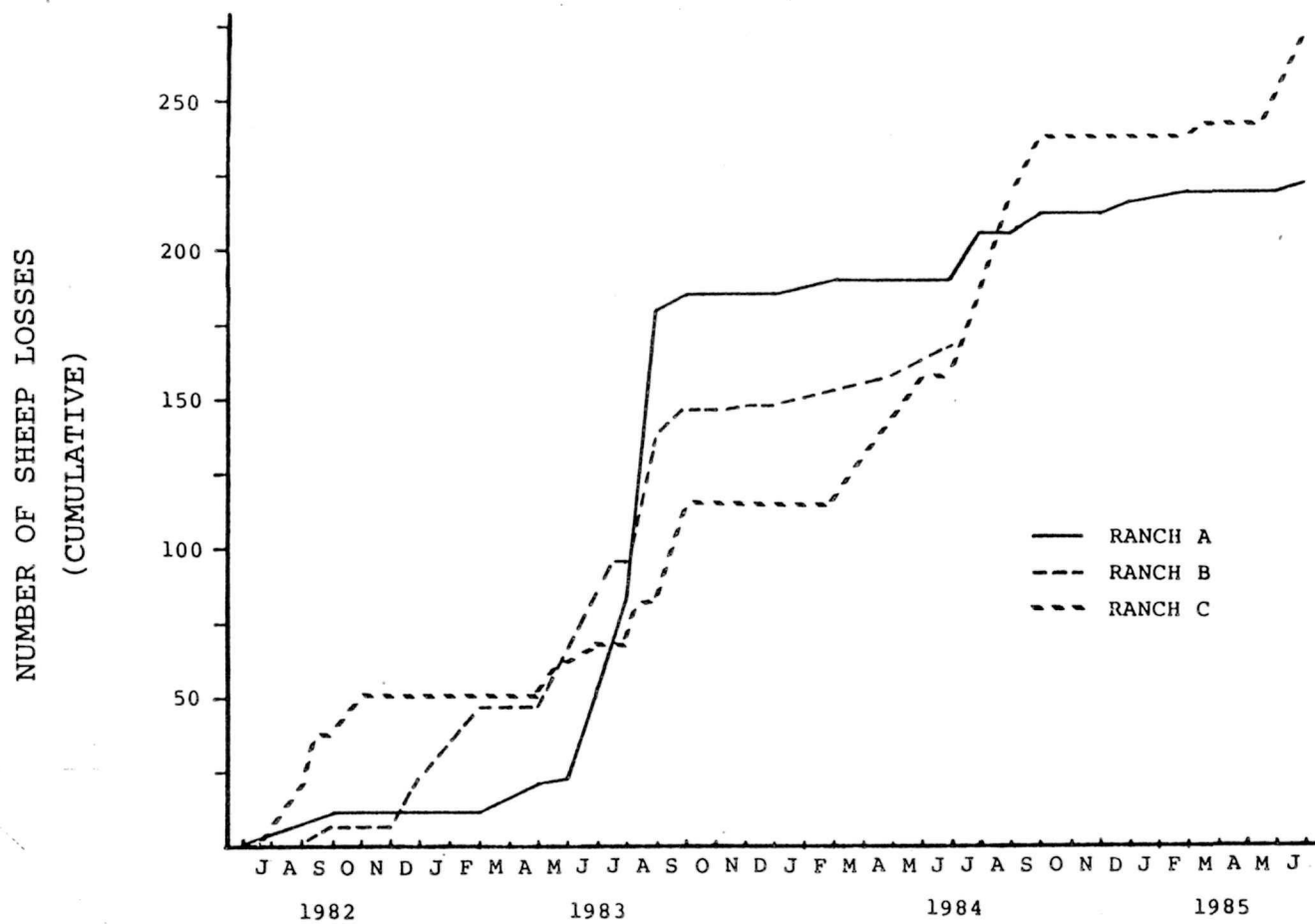
Carrion feeding was recorded from a calf carcass. During the spring of 1984 a calf was hit by a car in the LNF on State Highway 137. Several days later the carcass was dragged from its original location and fed upon by a mountain lion (N.Smith, NMG&F pers. comm.)

A colt was reported killed by a mountain lion on Ranch C in May 1983. Two more were missing and were presumed to have been killed by the same mountain lion. In late April 1985 the same ranch reported another colt killed. Judging from tracks, the rancher believed the mountain lion was a young male or an adult female.

Figure 37 represents reports by ranchers of dead sheep found with evidence of mountain lion predation for the indicated period. Totals are cumulative by ranch for the study period. Reports of mountain lion presence is included with reported mortalities and relocation data from radio-collared lions in Figure 38. Reports of individual mountain lions based on sign is subjective and much of the sign seen by ranch personnel may not have been reported. It is included in Figure 38 only for the purpose of indicating lion presence. Confidential reports from reliable sources regarding mountain lion mortalities are omitted from this figure but are included in mortality summaries.

Over a 36 month period from July 1982 through June 1985 664 sheep were reported killed by mountain lions on the three study area ranches north of both National Parks (Figure 37). The total number of sheep inhabiting the study area fluctuates annually with the birth of lambs in May. During the winter of 1982-83 the study area population, estimated by the ranchers, is believed to have been approximately 3790. By June the presence of lambs results in a population increase of approximately 90 percent or 7215 sheep.

The number of sheep grazed on Ranch A was intentionally reduced by approximately 33 percent, beginning in September 1983,



HARVEY AND STANLEY ASSOCIATES, INC.

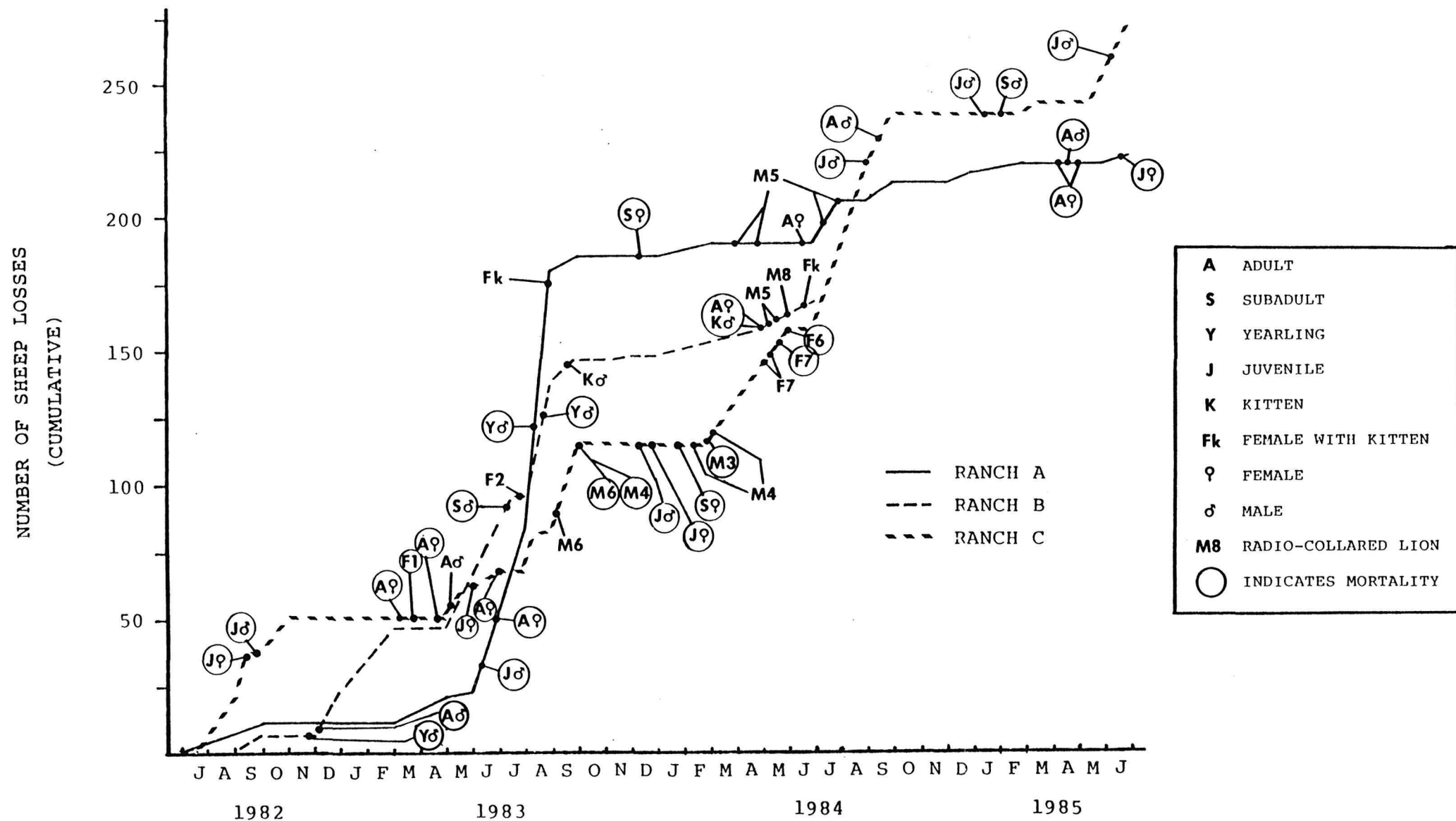
ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

MONTHLY DISTRIBUTION OF REPORTED
SHEEP LOSSES

File No 150-03

Date 11-27-85

Figure 37



HARVEY AND STANLEY ASSOCIATES, INC.

ECOLOGICAL CONSULTANTS • ENVIRONMENTAL PLANNERS • RESOURCE MANAGERS

RELATION OF LION PRESENCE
TO SHEEP LOSSES

File No. 150-03

Date 11-27-85

Figure 38

primarily as a result of mountain lion depredation. Concomitantly, Ranch B converted to a cattle operation in July 1984, by selling sheep at several intervals beginning in 1983. Ranch C has maintained virtually constant numbers during the course of this study. Because of these decreases the sheep population during the winter of 1984-85 is estimated at 2550 with a resulting summer population of 4763.

Eighty-five percent of all sheep losses were reported between April 1st and September 30th. The number of sheep lost during one night ranged from 1 to 15. The maximum number lost in a single month was 97, reported from Ranch A in August 1983.

The reported losses for each ranch are believed by the ranchers to represent approximately 40%, 31%, and 33% of the actual losses on Ranch A, B, and C, respectively. These subjective estimates are based largely on the severity of summer losses and the difference between numbers of lambs marked in spring and numbers counted at the time of the fall sale. The presence of sheep remains in stomach contents and fresh scats collected from 3 mountain lions on Ranches A and C during periods when depredations were not reported supports the rancher's claims that many lion-killed sheep are never found.

Mountain lion depredations have occurred on virtually all pastures on each of the 3 ranches. However, on Ranch A and C pastures with the highest rate of mountain lion depredation those that border the National Parks. On Ranch B most depredations occurred on the southern half of the ranch.

Depredations ceased on several occasions without the death of an offending lion. These cessations were most common during the fall and winter months but cessations of shorter duration were also noted between April and September when most losses occur. The cessation of losses in Fall and Winter is probably not only related to the smaller numbers of sheep present at this time of year but also by the resulting ability to restrict grazing to low risk pastures. However, moving sheep from pastures with high rates of depredation was not always effective. Ranch B moved sheep from the southern-most pasture on July 15, 1983 but

experienced heavy losses in August in the northwestern quarter of the ranch.

On one occasion depredations apparently ceased by one lion but were resumed within 3 weeks by 2 different mountain lions. Ranch C reported that 14 sheep were killed in late July and early August 1983. Thirty-three sheep reported killed in September 1983 were attributed to predation by M6 and M4. Radio-locations for M6 and M4 suggest that neither animals was in the vicinity of Ranch C at the time of the July-August depredations.

More than one mountain lion was noted on a sheep ranch during depredations (Figure 38). Several of these incidents involved family groups. In May 1983 members of M2's family group were apparently involved in depredations on Ranch C. One year later, F7's family group was involved in depredations on Ranch C within the same pasture. Other incidents that appear to involve family groups occurred during June and August 1983 on Ranch A, September 1983 and April 1984 on Ranch B, and September 1982 and December 1983 on Ranch C (Figure 38).

Other depredation incidents appear to involve various combinations of adult, subadult, and juvenile mountain lions. In September 1983 both M4 and M6 appeared to be involved in depredations on Ranch C. Tracks of an adult male were reported from Ranch C during depredations by the M2 family group in May 1983. In May and June 1984 M5, M8, and possibly M9 were in the vicinity of ranch B during a period of reported depredations. The offending lion, however, was believed to be a female with kittens. During depredations on Ranch A in July 1984 tracks were found that were suggestive of an adult female. Yet M5 was located on this ranch in early July and was closely associated with depredations in late July. An additional incident involving the presence of non-related mountain lions possibly occurred in August 1983 on ranch A when a yearling male was killed and a female with kittens was reported to have been killing sheep during forays based in CACA (Figure 38).

Within the small sample of radio-collared depredating lions, the largest reported sheep losses occurred with incidents involving more than 1 individual (M4 and M6) or a female with kittens (F7-F6).

Six of the 22 radio-collared mountain lions were known or believed to have killed sheep (F7, F6, M2, M4, M5, and M6). An additional 3 were possibly involved in depredations (F2, F9, M11). Of the 11 radio-collared mountain lions known or believed dead, 9 apparently died from predator control efforts (F1, F3, F6, F7, M2, M3, M4, M6, and M9), and 2 are believed to have been shot for sport and/or predator control (M1, M5). Six of the 11 dead lions were known or believed depredators (F7, F6, M2, M4, M5, and M6), and the remaining 5 were unconfirmed. A synopsis of the known or possible depredating lions follows.

F9-M11-- Despite her proximity to sheep range, F9 was never implicated in depredations while radio-collared. She may have been involved in depredations prior to her capture, however. A kitten, which may have been M11's littermate, was killed on sheep range before F9 was radio-collared.

No scats have been found to contain wool within F9's core area adjoining Ranch A. All scat samples containing sheep remains collected in CACA, other than the one collected from M5, were found along the northwest border of F9's range and predate F9's capture (Figure 22).

M4-- M4 preyed on sheep in February 1984 on the northern end of Ranch C. Radio-locations obtained in August and September 1983 suggest that M4 may have participated in depredations with M6. The center of activity (Hayne 1949) for M4 during the September 1983 depredations (N=8, 8/18-9/26/83) was 1 km (0.6 mi) further west (toward sheep range) than the center of activity for M6 (N=7, 8/18-9/20/83). This is added evidence that M4 may have participated in these depredations.

Radio-locations and the reported presence of large male tracks suggest that M4 may have been responsible for depredations occurring in March 1984 on the northern end of Ranch C.

M5-- A snare wire removed from M5 in April and the collection of a fresh scat from his bed site 2 weeks later indicates that M5 was killing sheep on Ranch A during a period of unreported depredations. During these depredations M5 bedded down in CACA at least once. It was not until 2 months later that M5 returned to the sheep range and preyed on sheep. Although M5 was known to have been on Ranch B in May 1984, his involvement in concurrent depredations was unconfirmed.

M6-- M6 apparently encountered sheep on Ranch C during his dispersal. Once arriving in the vicinity of this ranch in August 1983, he remained in the area until his death on September 20, 1983. Though not confirmed as a depredator, M6 was known to have moved toward the sheep during several nightly forays. Because the depredations apparently stopped when M6 was killed on September 20th, M6 was probably responsible for most of the kills discovered by the rancher. However, it is believed that M4 also was killing sheep in the same area during this time.

M8-- M8 frequented Ranch B but his involvement in depredations was never confirmed.

M9-- M9 ranged in the vicinity of Ranch B and was killed in a snare south of this ranch but he was not a confirmed depredator during the 3 months that his movements were monitored.

DISCUSSION

HOME RANGE

Home ranges of neighboring adult males were largely exclusive. Several of the adult males' home ranges overlapped spatially, but use of shared areas occurred at different times. The movements of an adult male into the vacated home range of a neighboring male, witnessed on several occasions, also supports the conclusion that adult male home ranges are exclusive. This is similar to the findings of Seidensticker et al. (1973) in Idaho and Hempker (1984) in Utah where very little overlap occurred, but different from studies in California (Sitton and Wallen 1976, Hopkins et al. in press) where adult male home ranges overlap to a greater degree. The home ranges of adult males also overlapped between 2-5 adult females in this study.

Adult female home ranges in this study commonly overlapped spatially, but the temporal overlap was less frequent. F4, with at least one 5-8 month old kitten, had a relatively large area of spatio-temporal overlap with the F10-M12 family group. F5 and the M2 family group may have displayed a similar amount of overlap. F5 and F7 occupied home ranges which appear to overlap, and both carried radio-collars at the same time, but data were gathered on F7 for only a short period before she was killed. During the time her collar was transmitting, spatial overlap with F5 was not observed.

Adult females in the study apparently adjusted the size of their home ranges based on whether they were alone, had young kittens, or had older kittens. When kittens were first born, home ranges were very small, as the females stayed near the natal dens. Between the time the kittens were about 1 and 5-6 months old, home ranges enlarged, but were still relatively small. Females F4 and F5's home ranges when accompanied by 1-6 month old kittens were 37 and 25 percent of their total home ranges, respectively.

Adult females accompanied by older kittens (5-6 months) and juveniles (7-18 months old) expanded their ranges greatly. This was seen in F9's home range when she was with M11 (5-8 months old), and in both the M2 and the F7 family groups which expanded their home ranges into sheep range as kittens matured. The home range expansion of the F7 family group differed in some respects to the expansion of the home range of the M2 family group. First, M2 and his littermate (Tattoo 03) were older than F6 and her littermate when their ranges expanded and they entered the pasture on Ranch C. The F7 family group apparently entered the sheep range at an earlier phase of their range expansion than did M2's family, possibly because the watershed they occupied was 40 % smaller and about 2.0 km (1.2 mi) closer to the southern border of Ranch C.

This pattern of home range expansion by adult females with older kittens and juveniles may explain the long movement of F2 into sheep range on her last known location. F2 was accompanied by a 4 to 5 month old kitten when captured in January 1983. If F2 was still with her offspring when last relocated in July 1983, they would have been juveniles approximately 11 or 12 months of age. If this July location was part of F2's region of site attachment, then her home range would have been larger than that recorded for any other adult female.

Adult female home ranges may occasionally be larger when they are with older kittens or juveniles than when the female is alone. F9's home range without dependant offspring was only 51 percent of the area used when accompanied by M11, an older kitten. No other females were radio-tracked after the known death or dispersal of their young.

The positions and orientations of home ranges, particularly of females, were strongly influenced by geographic features. These same features influence the likelihood of mountain lions crossing park boundaries. Where major ridges and canyons cross the boundary perpendicularly, mountain lions cross the boundary frequently (Ranch C). When the boundary runs parallel to these physical features, adult female mountain lions may spend proportionally more of their time on one side or the other of the

feature. However, if the terrain is sufficiently small in scale, such features may influence, but do not necessarily restrict movements.

The tendency of mountain lions to orient their home range along the axis of major topographic features is well illustrated with F9. She rarely bedded down out of the Walnut Canyon watershed. The boundary of this watershed closely parallels the eastern boundary of CACA. The inclusion of this complete topographic unit (Walnut Canyon Watershed) into the National Park distinguishes CACA and Ranch A from GUMO and Ranch C, where the Dog Canyon Watershed drains across park boundaries into Ranch C. F9's range and diet were probably also influenced by the ranchers' reluctance to graze sheep near the park boundary for most of the period that F9 was monitored.

The position and orientation of National Park boundaries relative to regional terrain was a major factor which influenced the tendency of mountain lions to coinhabit park and non-park lands. A variety of other factors influenced movements between park and non-park lands as well, especially the presence of broken terrain for bed sites, and the presence of vulnerable prey. Where sheep ranches border the National Parks (Ranches A and C) and broken terrain for bed sites exist just inside park boundaries, the probability of the park serving as refuge for a depredator is greatest. Mountain lion movement across park boundaries may also have been influenced by social behavior, including searching for mates, territorial marking, and other interactions with conspecifics. The division of all these factors across park boundaries and the varying importance of these factors to individual lions, influence the use of border areas.

DISPERSAL

Three dispersals were monitored in the study area. Two mountain lions (M5 and M6) dispersed within the study area and 1 (M2) dispersed out of the study area. M2 and M6 both moved long distances in relatively short time periods.

These long dispersals contrast with M5's movements as a juvenile which were in close proximity to his movements as a subadult and young adult male. This suggests that M5 may not have followed the typical pattern of a long dispersal and subsequent site-attachment. However, the location of his natal home range is not known, and he may have already dispersed a considerable distance with M6 before his initial capture. It is known that M5 as a juvenile, subadult and young adult male inhabited an area subject to intensive predator control. The periodic removal of adult males from these areas may enhance their attractiveness for site-attachment by juvenile and subadult males. The presence of neighboring adult females would increase the attractiveness of the area. M5 apparently moved into this kind of area and either did not disperse, or at least did not move as far in dispersal as his suspected littermate, M6.

Mountain lions mark their presence by a variety of visual and olfactory signals, as has been described. Dispersing juveniles that do not encounter these signals may site-attach after short dispersals, or possibly may never really undergo dispersal at all. Knowlton (1972) hypothesized that low densities resulting from intensive population reduction might reduce the stimulus for dispersal in coyotes (Canis latrans). However, Hempker (1984) observed that the dispersal of male offspring was independent of resident adult density for a low density mountain lion population in southern Utah.

MOVEMENT

Movements made by mountain lions vary with the age and sex of the individuals involved. The general trends were that adult males travel further than adult females whether the females had kittens or not. Females with young kittens move the shortest distances between bed sites. These movement trends are reflected in the corresponding home range size for each category.

Nocturnal tracking shows that using the distance between bed sites as an indicator of movement underestimates the real dis-

tance traveled. Adult females often made forays from centralized locations, returning to the same bedsite, or one nearby. The effect of this underestimation decreases as the distance between bed sites increases.

Mountain lions in the Guadalupe Mountains of New Mexico and Texas travel shorter distances between most daily intervals than has been found in studies in several other states. In Utah (Hempker 1984), adult females with 6-12 month old offspring traveled distances similar to those in this study at the 1 day interval, but traveled roughly twice as far on 2 and 7 day intervals. Adult females without kittens traveled twice the distance between locations on 1, 2 and 7 day intervals as adult females in this study. However, home ranges were 6-24 times larger for adult females in Utah. Adult males traveled similar distance to those seen in this study even though home ranges were 2-3 times larger. Movements noted in Idaho (Seidensticker 1973) suggest that adult males, females and females with kittens move distances equal to or slightly greater than those noted in this study.

Movement patterns of depredating radio-collared mountain lions indicate that the presence of sheep may be only one factor influencing movements of lions near sheep range. M2, a dispersing juvenile, encountered sheep during the transition between predispersal and dispersal movements. His presence on the sheep pasture was short lived as he dispersed well out of the study area and beyond sheep range. For resident mountain lions that live through a depredation incident, it appears likely that they will return to sheep pastures at a later date. Interim periods may be spent at varying distances from sheep pastures.

F7's attack on 2 sheep during the night of May 12th, 1984 suggests several interesting aspects of a depredating mountain lion's behavior. In the 70 minute period during which F7 entered the sheep pasture she traveled a minimum of 1.6 km (1.0 mi) and killed 2 sheep. The raid-like nature of the attack is consistent with reports of multiple kills and contrary to the general picture of stealth and patience usually considered necessary in attacking deer. It is also interesting to note that neither of the 2 kittens accompanied her during the attack.

Hempker (1984) found that adult females left their dependant offspring while hunting and later took them to the site of the kill.

ACTIVITY

Radio-collared mountain lions were usually stationary during the day, but motion sensitive radio-collars suggest that individuals spend varying amounts of time sleeping or involved in a variety of behaviors while awake. Initiation of activity near the time of sunset may be related to the relative exposure of the bed site to late afternoon sunlight. Movements generally began rather abruptly in the evening, but the morning bed site selection was a more gradual process.

Sunquist (1981) noted the close similarity of activity periods between tigers and their primary prey species but hypothesized that human influences (i.e. hunting) might affect activity. It is interesting to note that F5, in the backcountry of GUMO was observed moving at mid-day on 3 occasions while F9, located along state highway 7 in CACA, was rarely observed moving during daylight hours. However, there is natural variability in activity patterns of lions, so this difference may not be significant.

MORTALITY

The annual mortality of mountain lions fluctuated during the three years of the study, starting at 21 the first year, climbing to 25 the second, and falling to 19 during the third year. Differences between the 3 years is related to numerous factors influencing hunting or control effort. The decrease in the number of lions killed during the third year most likely resulted from the combined effects of reduced numbers of sheep on area ranches, and the periodic removals of sheep from problem pastures. There may have also been an overall reduction in the lion population size, but this was not determined.

The number of immature (juvenile, subadult, and unidentified yearling) mountain lions killed annually during the 3 years of this study steadily increased (Figure 33), from 7 to 9 and finally 10 animals. The number of males in this same group rose from 3 the first year, to 5 the second and finally to 7.

The increase in immature males killed may have been the result of an increase in young male immigrants in response to the removal of resident males. Hornocker (1970) and Seidensticker et al. (1973) hypothesized that behavioral mechanisms, present in stable populations, inhibit adult recruitment by a complex system of olfactory and visual stimuli. The removal of resident adult males and hence their stimuli might provide an open door for young immigrant males.

The number of radio-collared lions killed was 2 during the first year, 8 during the second, and 3 during the final year. No particular significance is attached to annual differences in these data.

The maximum number of adult mountain lions in the study area was estimated to be 24. Mortality for this age group during the first year was 10 animals, then 12, and finally 8, or mortality rates ranging from 33-50 percent. Studies conducted in the Ruby Mountains of Nevada (Ashman et al. 1983) indicate that a population of approximately 35 lions in a 724 km² (362 mi²) area sustained mortality of 30 percent per year for 6 years. However 50 percent mortality per year for 2 years reduced the population significantly and it took 3 years to recover. If Ashman's findings apply, then the population is being harvested either at or beyond the maximum sustainable yield. That is, the population may not be able to remain stable with this high mortality rate.

The high rate of adult mortality seen in this study, is combined with 58-83 percent mortality for the juvenile-subadult age-class. Field work showed 12 animals in the juvenile-subadult age class in the study area, but within this group, 7 animals were killed the first year, 9 the second, and 10 the last.

These high rates suggest that there is recruitment from areas not influenced by the 3 major centers of mortality due to predator control. In addition to young which are produced within the study area, there is apparently significant immigration from outside the study area. This would be consistent with findings for two heavily hunted regions in Idaho and Montana where the stability of the population was apparently dependent on immigrants from backcountry areas (Kerry Murphy, pers. comm, Murphy 1983).

The mortality and telemetry data reveal regions where adult survival within the study area should produce immature and adult recruits. As these recruits search for available habitat for site attachment, some may have encountered the heavy mortality regions. Additionally, some of the juvenile and subadult mortalities during the second and third field years were probably immigrants from north of the study area. Murphy (1983) felt that the population of lions in his heavily hunted study area probably did produce emigrating lions, but that these were outnumbered by immigrants from beyond the area.

The nine radio-collared lions captured during the first year transmitted an average of 118 days during the study year. During the second year a total of 14 lions were monitored with an average of 199 transmitting days per lion. Thus, during the second year more of the population was radio-collared and on the average, carried functional transmitters longer than during the first year. This increased the probability of losing radio-collared lions to predator control efforts and may explain, in part, the increase in mortality for radio-collared lions during the second year. Only five additional lions were captured during the third year. Capture efforts were intentionally focused away from mortality region 3. Of the 3 radio-collared lions killed during the third year, 2 were captured during the second field year.

The difference in survival among radio-collared lions appears to be a function of sex and age and the proximity of their home range to these regions of high mortality due to predator control. The size of the home range seems to be a factor in determining

the degree of vulnerability. Lions that travel over large tracts of land such as dispersing, transient, (M6 and M2) or resident males (M1, M3, M4, and M5), are likely to encounter a region of intensive control. Because of their smaller home ranges resident adult females might live for years within the radius of a control area that may prove fatal to several consort males during her lifetime (F5 and M3, F4 and M1, F9 and M5). An adult female raising young kittens typically occupies a small home range, which would significantly reduce her vulnerability to trapping, even when she lives near a control area.

The overall impact on the regional lion population of the existing localized control efforts is apparently diffused by the immigrants produced beyond the regions of control. The dispersals of young lions which have been monitored in this study are evidence of the ability of the population to repopulate areas where lions have been removed. However, a system of blanket control spread over large areas, which has sometimes been proposed, would have more profound effects.

NATALITY

Data regarding the average number of young at birth are limited. There was an average of 3.3 kittens in utero from three prenatal litters known from the study area. Most postnatal litters have consisted of 2 kittens though litters of 1 and 3 have also been found. Mortality in utero has been noted and it is likely that some mortality occurs during the first weeks of life. Hempker et al. (1982) found that survival to 10 months of age was 70 percent for kittens first observed at or before 4 months. The high mortality of reproductive adults in this study is certainly a major factor affecting productivity.

DENSITY

Mountain lions are among the most difficult of the large North American Game animals to census. Anderson (1983), in reviewing density estimates from a variety of studies, felt that the most

accurate method shown to date for the estimation of mountain lion numbers was to radio-collar or otherwise identify all individuals in the population through intensive capture efforts. Because of the large area encompassed by this study, the rapid turnover of the population, and funding limitations, this was difficult to achieve, even for smaller areas within the study area.

Our estimate of the maximum population density for the study area is based in part on the discussions above. We have taken field observations of the densities for various age classes in known areas and extrapolated them for the entire study area. This extrapolation makes several assumptions.

1. There are no significant differences in the habitats within the study area, and therefore carrying capacity is similar.
2. All lions within each age-class were detected in the selected sample areas.
3. Fecundity for the population is similar to the average figures reported by Anderson (1983).

An additional factor which can affect the accuracy of the extrapolation is that some animals will have home ranges which extend beyond the 259 km² (100mi²) sample area. Some of these animals will be counted more than once in the extrapolation.

If the above assumptions and considerations are met, a maximum of 36 juvenile, subadult, and adult lions is the best estimate of the population for the study area. The inclusion of independant, non-breeding juveniles and subadults in this estimate, while not customary in other studies, is thought to better reflect the population size.

We have estimated that 22 or more kittens may be produced annually in the study area, based on extrapolation and presumed fecundity. If an estimate of 70% survival is used for kittens reaching 12 months of age (Hempker et al. 1982, Anderson 1983) then approximately 15 kittens will survive to that age. This

would be similar to the estimate of 12 lions extrapolated earlier from field data. However, the two are not strictly comparable. The higher figure is based on annual productivity while the lower figure is meant as a maximum estimate of yearlings occurring within the 2 month period. The latter estimate may include immigrants in addition to those produced on the study area.

The independent juvenile and subadult (yearling) segments of the population may have been underestimated by the methods used in this study. First, probability of a female raising her offspring to dispersal age was low due to the areas of high lion mortality. Second, when juveniles disperse from nearby regions, their transient nature may result in only brief stays within a given region, adding to the difficulty of detecting their presence. Finally, the decision to expend capture efforts in a given region often was based on the consistent presence of sign, a method favoring capture of resident adults.

Dispersing immature males probably travel longer and further in search of suitable areas for site attachment in order to avoid adult resident males. Their extended dispersal or transiency may result in greater mortality. Immature females, however, do not appear to avoid other adult females in a territorial fashion and thus might find suitable areas for site attachment sooner and perhaps closer to their birthplace (Seidensticker et al. 1973).

A generalized age and sex ratio for adult resident animals can be derived from the above estimates. Among the resident adults approximately 8 would be male, and 16 females, or a ratio of 1 male/2 females. This sex ratio is different from the 1/1 ratio expected at birth, and suggests high mortality for males either as kittens or, more likely, as yearlings (Fig. 33). It closely corresponds to results of other studies including 1/2 found by Murphy (1983), 3/6 found by Seidensticker et al. 1973, and 3/7 (Shaw 1982)(as reported by Murphy 1983).

Interestingly, the sex ratio of the known mortalities did not reflect the suggested higher mortality for males, at least in the overall sample. In fact, of the 65 mortalities reported, 31 were male, 31 female, and 3 were undetermined. Anderson (1983)

reviewed 23 samples of mortality records and found that most (18/23) showed sex ratios which were not significantly different from 1/1. However, in this study, for the juvenile/subadult/yearling group, there were 16 males to only 9 females. This is a ratio of 1.7/1, and indeed shows that young males did have higher mortality rates than young females, at least in regions of predator control.

FOOD HABITS

Kill Analysis

Deer are the most important prey species for mountain lion populations in North America (Russell 1978). This finding holds true for the Guadalupe Mountains as well. The composition of 22 lion-killed deer from the Guadalupe Mountains is very similar to the composition of 40 lion-killed deer from Idaho (Hornocker 1970). In Idaho, 62.5 % of the deer were either young or old compared to 61 % in this study. Further, 40 % of all deer killed in Idaho were fawns, compared to 41 % in this study. Hornocker (1970) concluded that lions in Idaho preyed on fawns and mature bucks with greater frequency than their occurrence in the population. Similarly, Ackerman et al. (1984) in Utah found that deer over the age of 7 years were taken more frequently than expected. The age and sex composition of the deer population for the study area is not known but is probably different between the heavily hunted LNF and the National Parks where hunting is prohibited. Consequently, comparisons between the lion-killed sample and the deer population is not possible. However, more fawns appear to be consumed when their availability is greatest after fawning in late July and August. The predation by M2 or his female littermate (Tattoo 03) determined by tracks in the snow indicate that young mountain lions occasionally kill their own prey.

Two observations of feeding behavior suggest that lions may feed on carrion more often than generally assumed. In addition to the incident with the road-killed calf, M2, a kitten at the time, fed on the remains of a cow elk killed by another lion, possibly his mother. The carcass was several weeks old, and had not been recently fed upon when M2 found it (or returned to it). The meat

was preserved by several weeks of cold weather during this time. Lions have also been known to feed from carrion in Utah (Ackerman et al. 1982).

SCAT ANALYSIS

The scat analysis revealed a minimum of 11 species of prey in the diet. Taken collectively with reported prey species, a minimum of 13 species has been found in the diets of mountain lions from the Guadalupe Mountains. Deer were, by far, the most important prey species occurring in the diet on an annual and regional basis. The frequency of occurrence of fawns relative to older deer in scats (34%-see table 10) is less than the 41 % noted in the kill analysis. The smaller percentage in scats may have resulted from the inclusion of scats containing non-aged deer remains into the older deer category. This would have resulted in an inflated percentage of older deer relative to fawns. Porcupines were second in importance, followed by lagomorphs and sheep. On a regional basis the frequency of occurrence in scat for porcupine shows an inverse relationship to the frequency of occurrence for deer. Consumption of porcupine was greatest in the pinyon-juniper zone, represented by the LNF.

Ackerman et al. (1984) hypothesized that adult males prey on small species more frequently than females with dependant kittens. This would allow males to maximize movement for breeding opportunities. Comparisons between scrape and non-scrape associated scats provides insights into sex specific food habits and provides a test of Ackerman's hypothesis. Two assumptions were made in the following interpretation of Table 14.

1. Scats at scrape sites are deposited by male mountain lions.
2. Scats not associated with scrape sites are deposited by all members of the population.

Comparison of the scrape and non-scrape samples suggests that the food habits of adult male mountain lions does not differ greatly from the general population. However, comparisons between these samples provide only a gross indication of differences because of the potential for male deposited scats in the non-scrape associated sample. Scraping behavior by male lions may simply not be possible in many circumstances in the rocky, desert conditions of much of the study area.

Ackerman et al. (1984) derived a regression equation from feeding trials with captive mountain lions that yields estimates of prey consumed using frequency of occurrence data from scats. Conclusions from his work indicate that small prey are overrepresented in terms of weight and underestimated in numbers when compared with frequency of occurrence values. This finding would suggest that lagomorphs and possibly porcupines may not contribute significantly to prey biomass, they are preyed upon more frequently than indicated by the frequency of occurrence data.

DEPREDACTIONS

There is no common trend in the annual losses of livestock of the 3 ranches. The increase in depredations between April 1st and September 30th is best explained by the concurrent increase in the sheep population after lambing. During the 3 years that depredation reports were received losses were greatest between July 1, 1983 and June 30, 1984 with 309 sheep killed. Losses decreased by 47 percent in 1984-85. This is largely due to the complete conversion of Ranch B from sheep to cattle by July 1, 1984 and a decrease in sheep numbers on Ranch A. During this same period (March 1985), a mountain lion depredation control program was initiated by the state of New Mexico. Five mountain lions were killed on Ranches A and B without concurrent evidence of depredation. The effect of this program on reducing sheep losses in the spring lambing of 1985 is unknown, in light of the reduction in sheep numbers, and the fact that overall, fewer lions were killed in 1984-1985 than in the other study years.

There are many variables affecting the reported sheep losses and details regarding mortality. The rancher's ability to search for losses, time of year, social and political attitudes, and involvement of radio-collared mountain lions, affected the amount of detailed information received.

Many of the periods where depredation apparently stopped on individual ranches can be explained by the death of the offending lion or the absence of sheep from vulnerable pastures. However, in some cases depredations ceased without obvious cause. The movement and depredation pattern of M4 and M5 indicate that predation on sheep may be periodic as the individual returns to regions of his home range where sheep are not present. This movement apparently is made in part to maintaining contacts with mates and competitive conspecifics. Site attached adult females and other males are probably encountered off ranch property more often because control efforts may inhibit the formation of resident populations on sheep ranches. Conversely, on several occasions unrelated mountain lions apparently interacted near sheep pastures.

M2 and F7/F6 were the only family groups known to be involved in depredations while radio-collared. Their depredations apparently began as the family groups expanded their home range. Once the depredations began they frequently preyed on sheep until the family group was killed or members dispersed.

M6, a dispersing juvenile male, remained in the vicinity of Ranch C after his arrival on or near August 18, 1983 until his death on September 20, 1983. His probable lack of experience in prey acquisition and the presence of large vulnerable prey (sheep) on Ranch C may have been factors influencing his brief site attachment there. The higher mortality of young males seen at the sheep ranches indicates that this may be a common pattern.

DEPREDACTIONS AND THE NATIONAL PARKS

All 3 sheep ranches lie within suitable mountain lion habitat contiguous with the National Parks. The frequency of mountain lion mortalities, the presence of females with kittens, the movements of radio-collared lions, and the continued presence of mountain lions in pastures after sheep are removed are all evidence of the suitability of the habitat.

The home range configuration of mountain lions M5 and F9 indicate that mountain lions in the vicinity of Ranch A make major movements in an east-west orientation following the axis of topographic features. However, once in the vicinity of Ranch A, nightly movements may, at times, be made from a centralized location offering secluded bed sites. The presence of such sites within CACA may result in a mountain lion bedding down within the National Park while depredating on the adjoining ranch. The home range of F9, though not a confirmed depredator, illustrates this potential. However, both radio-collared and non-radio-collared mountain lions have been known to bed down on Ranch A.

Despite the fact that Ranch B does not border the National Park it has been seen that 2 lions (M5 and M8) and possibly a third lion (M9), known to inhabit varying portions of the National Park, have also inhabited this ranch. However, these coinhabitants were all males. With the possible exception of F2, neither of the 2 adult females (F3 and F9) resident in CACA were ever located on Ranch B. This is not meant to suggest that they have never visited the ranch or killed sheep but it does suggest that if these lions have been involved in depredations, they are doing so less frequently than others. However, dispersing offspring produced by these females, as with other neighboring females off park lands, might pose a problem.

The presence of rugged non-park land between Ranch B and CACA provides potential bed sites outside or bordering the National Park. This reduces the potential of depredating mountain lions returning to refugia offered within the park. Yet in situations

where a depredating lion on Ranch B beds down in this interlying area, pursuit with hounds may lead into CACA.

Unlike ranches A and B, the home range configurations of mountain lions in the vicinity of Ranch C are oriented in a north-south direction. The physiognomy of topographic features along the boundary between Ranch C and GUMO run perpendicular to the northern boundary of the park. The influence of this terrain on mountain lion movement and depredation is well reflected in the home range expansion of F7-F6 and M2, and the dispersal route of M2.

The broken terrain within GUMO and along the western boundary of the LNF were repeatedly used as bed sites by M2, M3, M4, M6, F1 and F7-F6. Both M6 and M4 illustrate the potential of problem mountain lions to enter Ranch C from this rugged non-park land east of this ranch.

MANAGEMENT--CONTROL AND PROTECTION

The sharp contrast between management goals on and off park lands creates a situation where each objective is difficult to achieve. Basically, the goal for non-park property is to control the mountain lion depredation problem. Within the park, protection of the natural resources, including the mountain lion is the goal.

The presence of 2 National Parks within the southern portion of the Guadalupe Mountains underscores public and scientific opinion of the unique natural resources inherent to the region. The restrictions pertaining to consumptive use (i.e. hunting) of park resources is consistent with the goal of the National Park Service to "preserve and protect" natural resources within park boundaries.

All 3 sheep ranches in the study area are within the State of New Mexico. In this state the mountain lion is classified as a game animal and, accordingly, the state is responsible for damage to private property by animals of this status. The state's

management goal to control damage resulting from mountain lion predation on livestock is consistent with department policy.

Further complicating the issue is the fact that mountain lions which coinhabit the National Parks and sheep range and are killed will consistently be replaced by immigrating lions, given the present population characteristics.

Control

The presence of the National Parks occasionally affects the success of predator control efforts along park borders, but this is only one of several proximal factors affecting the success of these control activities. Ultimately, the factor affecting reoccurring sheep losses is ingress from the population inhabiting the Guadalupe Mountains. The population within the National Park boundaries is apparently stable and, while protected, will continue to produce lions which may enter sheep range. Additionally, there is apparently a stable, mature population within the Lincoln National Forest which also contributes to the set of lions which prey on sheep. The LNF is indistinguishable in this regard from portions of the National Parks not impacted by predator control, and probably contributes immigrants to the areas of sheep loss. Adjoining mountain ranges north and south, undoubtably contribute immigrants to the Guadalupe Mountains as well.

Following the format outlined by Russell (1978), goals, objectives, strategies, and tactics can be defined for both the National Parks and state natural resource agencies. Although general goals have been stated above, specific goals may need to be defined by both agencies with recognition given to the unique needs of both management and preservation of mountain lions in the Guadalupe Mountains.

A realistic objective for state control efforts, given the current status of the lion population, is to minimize, rather than attempt to eliminate, depredations. There are numerous problems to face in meeting this objective.

The experience of the past years has shown that simply hunting for mountain lions after depredations are discovered is not an effective means of controlling sheep losses. Desert conditions make trailing with hounds very difficult. Only the best desert-trained hounds are successful in trailing under these conditions. Catching the lion with hounds often requires repeated attempts, and of course sometimes a depredator is trailed to the edge of the National Parks.

Another alternative, under these conditions, would be not only to hunt depredators when they are detected, but attempt to remove (kill) any mountain lion detected from the ranch. Waiting for sheep to be killed before initiating control efforts could and has resulted in repeated losses before the offending lion is removed.

A policy of preventative removal is, in essence, what the state of New Mexico adopted in the Spring of 1985 to control depredations on 4 sheep ranches within the Guadalupe Mountains. Three of these ranches lie inside the study area (Ranches A, B, and C). Tactics used with this strategy include the use of traps, snares and dogs to be used only within the confines of the ranch. Whether such a program is effective in reducing sheep losses remains to be seen. This strategy has been used to varying degrees by individual ranchers in the past and it is the effect of more intensive efforts which is the key unresolved question.

While the practice of preventative removal would not always target the problem individual, if localized, it may reduce sheep losses with minimal impact to the regional mountain lion population. However, this type of program is costly for the regional population in that it can potentially drain a number of its breeding residents, in addition to present and future recruits.

Moving sheep from problem pastures is effective in reducing losses, but ranchers are understandably reluctant to do so when lambs are present. After lambing, conditions are often hot and dry. Moving sheep over rough terrain at these times often results in sheep deaths. In addition, the resulting burden placed

on other pastures ultimately requires a reduction in sheep numbers. Reduced numbers mean reduced profits.

However, sheep should not be placed in high risk pastures when other alternatives are available. Avoiding the use of problem pastures when sheep numbers are low may be a way to reduce sheep losses and limit mountain lion mortality.

Liberalizing sport hunting regulations as a method of reducing depredations would not direct effective effort into regions where control is needed. Expanding the region of predator control beyond the area where sheep are being killed, would be a costly and ineffective method of reducing depredations. This would also remove individuals that might provide consumptive enjoyment for sportsmen or non-consumptive enjoyment for park visitors.

Management

The National Park Service has jurisdiction over the wildlife within its boundaries and the states of New Mexico and Texas have jurisdiction in the surrounding areas. This poses a problem in that it charges several different agencies, having differing objectives, with the responsibility of managing the mountain lion population within the Guadalupe Mountains. Because of the small size of both National Parks relative to the area occupied by the mountain lion population, the National Park Service can do little to insure the status of the regional population.

In accordance with the principles outlined by Holt and Talbot (1978);

"The consequences of resource utilization and the implementation of principles of resource conservation are the responsibility of the parties having jurisdiction over the resource or, in the absence of clear jurisdiction with those having jurisdiction over the users of the resource."

Although patrons of the National Parks are users of the mountain lion resource, their use is non-consumptive and does not seriously impact the resource. The consumptive effects of predator control and sport hunting are both carried out within the jurisdiction of the state natural resource agencies.

Due to the demand for recreational and non-recreational utilization of the mountain lion population in the Guadalupe Mountains, a comprehensive, interagency management plan would be desirable. The current population appears to support heavy, localized mortality under present conditions. However, it is a heavily exploited population, one which apparently is stable at least in part due to large numbers of immigrants. It is therefore susceptible to a variety of other environmental factors which affect the survival of mountain lions. Thus, it is important for responsible agencies to cooperate in order to insure responsible management.

We suggest that an interagency task force be assembled, primarily with New Mexico Game and Fish and National Park Service personnel, but with other interested and responsible parties included. The group should certainly include BLM representatives, because much of the sheep range in question is actually BLM land leased for grazing. It should also include the U. S. Forest Service, which administers the LNF. This task force then would be charged with coordinating management and control efforts.

Certain key elements are necessary in responsibly managing mountain lion populations in the vicinity. These elements could form the basis for interagency interaction on the task force described above, but they should certainly be considered independently by the National Park Service. A series of recommendations follow:

1. The first charge is to assist the ranchers in judicious management of their sheep. If sheep losses can be kept to an acceptable level through movement of sheep from problem pastures, and through specific, directed predator

control, then there may indeed be a better situation all around.

2. The second charge is to continue to gather data regarding mountain lion mortalities. While this is primarily the responsibility of the New Mexico Department of Game and Fish, it is a key element in determining the health of the mountain lion population. With several additional years of data, long term trends may become apparent which did not appear in the three year study. Efforts should be made to collect scientific data prior to planned use (Holt and Talbot 1978). This would entail a concerted effort to gather information regarding the age, sex, reproductive status, physical condition, and specific location of each mortality.

3. The third recommendation is directed to the National Park Service particularly, but applies broadly as well. A heavily exploited population such as this, is particularly susceptible to changes in prey density. That is, since deer occur in 82% of the scat samples taken in the area, the health of the deer herd is particularly important. Within the National Parks we recommend that a systematic monitoring of the deer population begin. This should include not only charting the deer population densities, but an analysis of the range itself, and its ability to support the deer.

4. Fourth, the National Park Service should continue, in some limited fashion, to monitor the lion population within the park. They should employ qualified personnel to promote and maintain observation records within the parks of mountain lion sightings, tracks, scrapes and deer kills, preferably on a systematic basis. These data would have value in determining mountain lion presence and possible trends within the National Parks.

5. The final recommendation is to examine the effects of mountain lion mortalities from sport hunting separate from the issue of depredation. It appears that limiting the mountain lion deaths to specific, limited areas (i.e. sheep

pastures), has the least possible impact to the regional lion population because of the ability of non-exploited areas to produce animals which replace those that are lost. Conversely, widespread killing of lions through sport hunting may have more significant effects. The New Mexico Department of Game and Fish has recently begun a study of the effects of sport hunting which hopefully will answer some of the questions regarding the effects of widespread mortality. This information would benefit the management of lions in the vicinity of CACA and GUMO. We are not recommending that the Game and Fish study be duplicated, but that the findings be applied to management of this region. The study as we understand it is long term (10 years), and our recommendations therefore may be interim. If the Park Service or an interagency management team begins to notice a decline in the mountain lion population, then a reasonable first step would be to reduce sport hunting in the adjoining lands, while continuing to concentrate predator control in the problem ranches. Likewise, if more intense predator control is required on these ranches, then a reduction in sport hunting mortality should be considered to balance the increased predator control mortality. Such a balance should be one of the goals of the interagency group we have suggested.

LITERATURE CITED

- Anderson, A. E. 1983. A critical review of literature on puma (Felis concolor). Colo. Div. Wildl., Wildl. Res. Sect. Special Rep. No. 54. 91pp.
- Ashman, D. 1978. Mountain lion investigations. Nev. Dep. Wildl., Reno. 10pp.
- Browns, D. E. 1982. Biotic communities of the American Southwest; desert plants, U.S.--Mexico. Univ. Arizona Spec. Publ. Southwest. Arboretum. 4:1-4.
- Clark, W., D. A. Jessup, and A. Adams. 1979. Animal restraint handbook. Calif. Dep. Fish and Game. 113pp.
- Danner, D. A., and N. Dodd. 1982. Comparison of coyote and gray fox scat diameters. J. Wildl. Manage. 46:240-241.
- Donaldson, B. 1975. Mountain lion research. Job Prog. Rep., P-R Proj. W-93-R-17, Work Plan 15, Job 1. New Mexico Game and Fish Dep. 18pp.
- Genoways, H. H., R. J. baker, and J. E. Cornely. 1979. Mammals of the Guadalupe Mountains National Park, Texas. Proc. Natl. Park Serv.
- Harvey and Stanley Associates, Inc. 1980. California mountain lion track transect survey. Rep. to Calif. Dep. Fish and Game, Prepared by Kutilek, M. J., T. E. Smith, R. A. Hopkins, and E. W. Clinite. 117pp.
- Hayne, D. W. 1949. Calculation of size of home range. J. Mammal. 30:1-18.
- Hempker, T. P. 1984. Population characteristics and movement patterns of cougars in southern Utah. J. Wildl. Manage. 48: 1275-1284.
- Hempker, T. P., F. G. Lindzey, and B. B. Ackerman. 1982. Survival of cougar cubs in a nonhunted population. In D. Everett (ed.), International Cat Symposium. Caesar Kleberg Wildl. Res. Inst., TX A&I Univ., Kingsville (in press).
- Holt, S. J., and L. M. Talbot. 1978. New principles for the conservation of wild living resources. Wildl. Monogr. No. 59. 33pp.
- Hopkins, R. A. 1985. Current techniques used in the research of Pumas. Pages 216-229 in J. Roberson and F. Lindzey, Eds. Proc. Second Mt. Lion Workshop, Zion National Park, Utah, November, 1984. Utah Division Wildlife Resources. 271pp.

- Hopkins, R. A., M. J. Kutilek, and G. L. Shreve. 1982. Density and home range characteristics of mountain lions in the Diablo Range of California. Proc. Intl. Cat Sympos. Kinsville, Texas. (In press).
- Hornocker, M. G. 1970. A analysis of mountain lion predation upon mule deer and elk in the Idaho Primitive Area. Wildl. Monogr. 21:1-39
- Knowlton, F. F. 1972. Preliminary interpretations of Coyote population mechanics with the management implications. J. Wildl. Manage. 36:369-382.
- Kutilek, M. J., R. A. Hopkins, E. W. Clinite, and T. E. Smith. 1983. Monitoring population trends of large carnivores using track transects. Pages 104-106 in Proc. Intl. Conf. Renewable Resources Inventories for Monitoring changes and trends. School of Forestry, Oregon State Univ., Corvallis. 737pp.
- McBride, R. T. 1976. The status and ecology of the mountain lion (Felis concolor stanleyana) of the Texas-Mexico Border. M. S. Thesis, Texas State Univ., Alpine. 160pp.
- Mohr, C. O. 1947. Table of equivilent populations of North American small mammals. Am. Midl. Nat. 37:223-249.
- Moore, T. D., L. D. Spence, C. E. Dugnette, and W. G. Hopworth. 1974. Identification of the dorsal guard hairs of some mammals of Wyoming. Wyo. Game and Fish Dep. Bull. No. 14. 117pp.
- Murphy, K. M. 1983. Characteristics of a hunted population of mountain lions in western Montana. Montana Dept. Fish Wildl. and Parks. Project No W-120-R-13,14. 48pp.
- Murie, O. J. 1954. A field guide to animal tracks. Houghton Mifflin Co., Boston, Mass. 374pp.
- Quimby, D. C., and J. E. Gabb. 1957. Mandibular dentition as an age indicator in Rocky Mountain elk. J. Wildl. Manage. 21:435-451.
- Rabb, G.B. 1959. Reproductive and vocal behavior in captive pumas. J. Mammal. 40:616-617.
- Robinette, W. L., D. A. Jones, G. Rogers, and J. S. Gashwiler. 1957. Notes on tooth development and wear for Rocky Mountain mule deer. J. Wildl. Manage. 21:134-153.
- Russell, K. R. 1978. Mountain lion. Pages 207-225 in J. L. Schmidt, and D. L. Gilbert, eds. Big game of North America: ecology and management. Stackpole Books, Harrisburg, Pa. 494pp.

- Schmidly, D. J. 1977. The mammals of trans-Pecos Texas. Texas A&M Univ. Press. College Station, Texas. 225pp.
- Seidensticker, J. C., M. G. Hornocker, W. V. Wiles, and J. P. Messick. 1973. Mountain lion social organization in the Idaho Primitive Area. Wildl. Monogr. 35:1-61.
- Shaw, H. G. 1979. A mountain lion field guide. Res. Div. Ariz. Game and Fish Dep. No. 9 27pp.
- Shaw, H. G. 1982. Comparison of mountain lion predation on cattle on two study areas in Arizona. Pages 306-318 in J. M. Peek and P. D. Dalke, eds. Wildlife-Livestock Relationships Symp. For., Wildlife, and Range Exp. Stn. Univ. Id., Moscow.
- Sitton, L. W., and S. Wallen. 1976. California mountain lion study. California Dep. Fish and Game. Sacramento, Calif. 40pp.
- Smith, T. 1981. Food habits and scrape site characteristics of mountain lion in the Diablo Range of California. M. A. Thesis, San Jose State Univ., San Jose, Calif. 34pp.
- Sunquist, M.E. 1981. The social organization of tigers (Panthera tigris) in Royal Chitawan National Park, Nepal. Smithsonian contributions to zoology; no.336. Smithsonian Institution press. 98pp.
- Wade, D. A., and J. E. Bowns. 1982. Procedures for evaluating predation on livestock and wildlife. Texas A & M Univ. College Station and U. S. Dep. Inter., Fish and Wildl. Serv. 42pp.

APPENDIX A

Mountain Lion Radio Relocations

RADIO-RELOCATION DATA
MOUNTAIN LIONS OF CARLSBAD CAVERNS
AND GUADALUPE MOUNTAINS NATIONAL PARKS

Note: UTM grid zones for these locations are 13R and 13S. Per standard procedure, only the 100,000 meter squares are identified.

* UTM LOCATIONS FOR MOUNTAIN LION F1
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	821221	152375	1
2	821222	156381	1
3	830101	135353	2
4	830112	188422	2
5	830201	146356	1
6	830202	146352	1
7	830306	167431	1
8	830308	175405	2
9	830320	165405	2
10	830321	166412	2
11	830322	166400	2
12	830327	158402	1

* UTM LOCATIONS FOR MOUNTAIN LION F2
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	830116	355521	1
2	830117	346521	1
3	830123	345519	1
4	830217	324472	2
5	830308	314470	2
6	830419	272447	2
7	830518	297452	2
8	830526	288445	2
9	830714	400640	2

* UTM LOCATIONS FOR MOUNTAIN LION F3
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	830207	441555	1
2	830217	428567	1
3	830217	427550	2
4	830304	450575	1
5	830308	392587	2
6	830419	448576	2

7	830518	416594	2
8	830526	425550	2
9	830608	457575	2
10	830610	459578	2
11	830615	428571	2
12	830615	428605	2
13	830712	443571	2
14	830713	456616	1
15	830713	449595	1
16	830714	448590	1
17	830830	440583	2
18	830926	422592	2
19	830927	402587	1
20	831029	498590	2
21	831118	416585	2
22	831121	372578	2
23	831128	395591	2

* UTM LOCATIONS FOR MOUNTAIN LION F4
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	830622	270602	1
2	830629	222649	2
3	830712	309613	2
4	830714	268576	2
5	830813	320601	2
6	830830	266648	2
7	830922	323618	1
8	830926	284619	2
9	830927	263640	2
10	830929	262631	2
11	831117	314614	2
12	831121	267645	2
13	831128	272597	2
14	831205	269590	2
15	831206	271588	1
16	831207	276602	1
17	831213	302604	1
18	831217	290611	2
19	840202	293643	2
20	840223	278661	2
21	840301	274607	2
22	840418	298661	2
23	840424	298671	2
24	840501	322640	2
25	840503	323640	2
26	840522	296610	2
27	840601	311647	2
28	840608	285651	2
29	840625	301640	2
30	840629	306633	1

31	840630	309637	2
32	840703	310639	2
33	840712	310646	2
34	840718	266632	2
35	840724	294651	2
36	840815	304619	2
37	840815	298626	1
38	840829	273601	2
39	840907	293597	2
40	840912	300600	2
41	840922	300603	2
42	840924	300600	2
43	841001	279568	2
44	841027	284607	2
45	841028	293603	2
46	841031	314607	2
47	841101	292604	2
48	841105	276603	2
49	841110	273607	2
50	841127	308616	2
51	850103	306619	2
52	850104	338626	2
53	850110	305603	2
54	850117	335639	2
55	850129	305615	2
56	850211	306606	1
57	850213	318645	2
58	850302	324629	1
59	850308	332607	2
60	850309	319644	1
61	850310	328636	1
62	850321	302673	2
63	850419	266597	2
64	850505	278601	2
65	850508	283604	2
66	850511	286603	2
67	850514	309619	1
68	850515	303604	2
69	850522	248641	2
70	850529	208615	2
71	850609	189600	2
72	850619	217657	2

* UTM LOCATIONS FOR MOUNTAIN LION F5
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	830629	165322	1
2	830706	169391	1
3	830712	118360	2
4	830714	204333	2
5	830726	120331	2
6	830830	116313	2

7	830920	133373	2
8	830921	122353	2
9	830926	189337	2
10	831005	112340	1
11	831006	134349	1
12	831029	127311	2
13	831118	126313	2
14	831121	123315	2
15	831128	136323	2
16	831216	167328	1
17	831217	176357	2
18	840123	131337	2
19	840202	127335	2
20	840207	118335	2
21	840213	142341	1
22	840215	151330	1
23	840223	168357	2
24	840301	162318	2
25	840312	138311	2
26	840316	157356	2
27	840330	162359	1
28	840411	156353	1
29	840418	155358	2
30	840424	169361	2
31	840501	118329	2
32	840503	116349	2
33	840522	116329	2
34	840530	114341	1
35	840601	116343	2
36	840608	171327	2
37	840625	168367	2
38	840712	111304	2
39	840724	118351	2
40	840815	118299	2
41	840823	167368	2
42	840829	116350	2
43	840907	116341	2
44	840912	169323	2
45	840922	095342	2
46	840924	090350	2
47	841001	118308	2
48	841105	134333	2
49	841108	167322	1
50	841110	142314	2
51	841221	179376	2
52	841223	176377	2
53	850103	193358	2
54	850104	189359	2
55	850110	185368	2
56	850117	187366	2
57	850208	154331	1
58	850213	160335	2
59	850224	151349	1
60	850308	165348	2
61	850321	166381	2

62	850508	163325	2
63	850519	153343	2
64	850529	162350	2
65	850609	125329	2
66	850619	125288	2
67	850629	164321	2

* UTM LOCATIONS FOR MOUNTAIN LION F6
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	840329	160385	1
2	840330	160385	1
3	840331	160381	1
4	840402	167381	1
5	840405	161380	1
6	840413	142370	1
7	840420	170378	1
8	840421	167381	1
9	840422	167380	2
10	840423	163379	1
11	840424	148380	2
12	840425	160380	1
13	840426	155382	1
14	840430	161380	1
15	840501	169399	2
16	840503	128387	2
17	840507	160381	1
18	840509	160380	1
19	840510	160376	1
20	840511	160380	1
21	840512	163409	1
22	840513	171432	2
23	840515	164403	1
24	840516	172435	1

* UTM LOCATIONS FOR MOUNTAIN LION F7
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	840413	141368	1
2	840420	170378	1
3	840421	167381	1
4	840422	167380	2
5	840423	163379	1
6	840424	148380	2
7	840425	160380	1
8	840426	155382	1
9	840430	160380	1
10	840501	169399	2
11	840503	128386	2

12	840507	160381	1
13	840509	160380	1
14	840510	161376	1
15	840511	160380	1
16	840512	160415	1
17	840513	171432	2

* UTM LOCATIONS FOR MOUNTAIN LION F8
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	840520	220486	1
2	840522	237468	2
3	840601	244467	2

* UTM LOCATIONS FOR MOUNTAIN LION F9
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	841028	509587	1
2	841030	484594	1
3	841105	565610	2
4	841106	563605	1
5	841107	563605	1
6	841108	555619	2
7	841110	577617	2
8	841112	576616	1
9	841113	548616	1
10	841114	546615	1
11	841115	546615	1
12	841116	535619	2
13	841117	521618	1
14	841118	502602	1
15	841126	470602	1
16	841127	502601	2
17	841206	555614	1
18	841209	530619	1
19	841210	546615	1
20	841211	546615	1
21	841212	541611	1
22	841213	546615	1
23	841214	533615	1
24	841215	546615	1
25	841219	503599	1
26	841221	478595	2
27	850103	471639	2
28	850110	464625	2
29	850114	558621	1
30	850116	557618	1
31	850117	560620	2
32	850124	565609	1

33	850125	566607	1
34	850126	553605	1
35	850127	586605	1
36	850128	558617	1
37	850129	558617	1
38	850130	558617	1
39	850131	558617	1
40	850202	534614	1
41	850203	555605	2
42	850204	566624	2
43	850205	500603	2
44	850206	497536	2
45	850210	558619	1
46	850213	566606	2
47	850217	558601	2
48	850219	546615	1
49	850221	546615	1
50	850222	546615	1
51	850226	546614	1
52	850227	575616	1
53	850228	546614	1
54	850310	583606	2
55	850311	583606	1
56	850312	583606	1
57	850317	532614	1
58	850321	546614	1
59	850322	546614	1
60	850323	576615	1
61	850329	500617	2
62	850331	546614	1
63	850418	515602	1
64	850419	546614	1
65	850419	542596	1
66	850420	546614	1
67	850422	546614	1
68	850423	576615	1
69	850508	546614	2
70	850515	564607	1
71	850518	561602	1
72	850519	548616	2
73	850522	555622	2
74	850529	556621	2
75	850604	556620	1
76	850605	557616	1
77	850609	556620	2
78	850611	555620	1
79	850619	572637	2
80	850620	557616	1
81	850623	546614	1
82	850624	556620	1
83	850629	548618	2

* UTM LOCATIONS FOR MOUNTAIN LION F10
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	841116	291565	1
2	841203	277566	1
3	841221	272601	2
4	850103	283564	2
5	850110	259577	2
6	850129	314614	2
7	850210	332614	2
8	850211	335610	1
9	850213	324602	2
10	850301	302587	2
11	850308	335619	2
12	850309	310623	1
13	850321	291596	2
14	850327	334611	2
15	850405	313619	1
16	850419	334589	2
17	850430	336611	1
18	850501	335623	1
19	850505	313628	1
20	850508	332608	2
21	850519	310639	2
22	850520	310602	2
23	850522	340610	2
24	850529	309560	2
25	850609	294654	2
26	850619	342547	2
27	850623	302562	2
28	850629	359611	2

* UTM LOCATIONS FOR MOUNTAIN LION M1
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	820902	212484	1
2	820906	337599	2
3	820929	343633	1
4	821122	248470	2
5	830112	336602	1
6	830117	307503	1
7	830128	250634	2
8	830217	266595	2
9	830219	263641	2

10	830308	340565	2
11	830328	227468	1
12	830518	271601	2
13	830622	354588	2

* UTM LOCATIONS FOR MOUNTAIN LION M2
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	821223	108379	1
2	821229	147355	1
3	821230	150342	1
4	830101	105363	1
5	830126	136338	2
6	830202	137336	2
7	830308	111365	2
8	830314	113357	1
9	830316	140357	1
10	830317	150350	1
11	830318	123326	1
12	830321	095365	2
13	830322	103371	1
14	830325	103368	2
15	830326	103368	1
16	830327	102364	1
17	830419	136373	2
18	830502	125391	1
19	830503	125391	1
20	830512	135372	2
21	830518	129419	2
22	830521	167536	2
23	830522	167540	1
24	830629	214835	2
25	830813	193811	2

* UTM LOCATIONS FOR MOUNTAIN LION M3
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	830701	156381	1
2	830703	168376	2
3	830706	179374	1
4	830712	170542	2
5	830714	226402	2
6	831004	115325	2
7	831216	169321	1
8	831217	196342	2
9	840213	166336	2
10	840215	155325	2
11	840218	182453	2

12

840223

174436

1

* UTM LOCATIONS FOR MOUNTAIN LION M4
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	830714	180315	1
2	830728	168313	1
3	830818	175439	2
4	830819	181454	2
5	830830	178478	2
6	830905	177484	1
7	830907	168415	2
8	830921	099385	2
9	830923	170440	2
10	830926	095474	2
11	831013	150552	2
12	831015	161550	1
13	831029	165442	2
14	831031	175435	2
15	831109	185515	2
16	831116	170470	2
17	831125	196509	1
18	831127	191492	1
19	831128	212486	2
20	831203	178489	2
21	831204	178489	2
22	831205	177487	2
23	831217	208510	2
24	840123	214457	2
25	840202	214469	2
26	840204	183457	2
27	840207	127544	1
28	840208	126544	1
29	840209	126544	1
30	840210	171548	1
31	840212	179504	1
32	840223	189507	2
33	840225	175537	2
34	840301	162550	2
35	840316	249550	2

* UTM LOCATIONS FOR MOUNTAIN LION M5
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	830808	354564	1

2	830830	369654	2
3	830908	379575	2
4	830926	440584	2
5	831029	485616	2
6	831118	456619	2
7	831128	555619	2
8	831205	450620	2
9	831217	490590	2
10	840123	457619	2
11	840202	474579	2
12	840207	570607	2
13	840223	499588	2
14	840225	437607	1
15	840301	552603	2
16	840403	560620	1
17	840415	538619	1
18	840430	534619	1
19	840503	451650	2
20	840522	456648	2
21	840608	406531	2
22	840609	467578	2
23	840703	551655	2
24	840712	485624	2
25	840718	462580	2
26	840724	549647	2
27	840815	408558	2
28	840823	502618	2
29	840829	394598	2
30	840907	467634	2
31	840912	460640	2

* UTM LOCATIONS FOR MOUNTAIN LION M6
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	830808	354569	1
2	830810	314576	1
3	830818	178478	1
4	830819	180474	2
5	830820	182456	2
6	830830	175445	2
7	830906	135407	2
8	830918	173456	1
9	830920	130410	2

* UTM LOCATIONS FOR MOUNTAIN LION M7
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	830811	322603	1

2	840202	280612	2
3	840207	229668	2
4	840223	317639	2
5	840225	236622	1
6	840312	291669	2
7	840501	230643	2
8	840503	224656	2
9	840522	244702	2
10	840601	217645	2
11	840608	237764	2
12	840625	294639	2
13	840712	260567	2
14	840718	244534	2
15	840724	233643	2
16	840815	253599	2
17	840815	207593	2
18	840823	247530	2
19	840829	345608	2
20	840907	250555	2
21	840912	226759	2
22	840922	282707	2
23	840924	216652	2
24	841001	293678	2
25	841105	253678	2
26	841110	251673	2
27	841127	255502	2
28	841221	218501	2
29	850104	290688	2
30	850110	291481	2
31	850117	230740	2
32	850129	236699	2
33	850210	341632	2
34	850213	281564	2
35	850308	298677	2
36	850321	210614	2
37	850419	181554	2
38	850502	180504	2
39	850519	222658	2
40	850522	329651	2
41	850609	261697	2
42	850623	319651	2
43	850629	214467	2

* UTM LOCATIONS FOR MOUNTAIN LION M8
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	840410	364582	1
2	840501	384660	2
3	840503	409667	2
4	840522	506604	2
5	840601	425648	2
6	840608	494616	2

7	840625	406607	2
8	840703	465617	2
9	840718	462646	2
10	840724	401667	2
11	840815	395656	2
12	840823	347611	2
13	840829	402665	2
14	840907	343646	2
15	840912	406660	2
16	840922	369650	2
17	840924	407670	2
18	841001	422692	2
19	841019	334562	1
20	841029	317564	2
21	841105	371521	2
22	841110	367520	1
23	841114	321602	1
24	841115	342604	1
25	841127	364598	2
26	841221	382594	2
27	841226	360604	2

* UTM LOCATIONS FOR MOUNTAIN LION M9
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	840416	332601	1
2	840608	421626	2
3	840609	416618	2
4	840625	396657	2
5	840703	339639	2
6	840712	404582	2
7	840718	396590	2

* UTM LOCATIONS FOR MOUNTAIN LION M10
LOCATIONS ARE IN 100,000 METER SQUARES EF AND EE AS NOTED

	DATE	UTM LOCATION	TYPE
1	841005	EF211327	1
2	841006	EF229312	1
3	841105	EF163358	2
4	841127	EF345075	2
5	841221	EE315895	2
6	850104	EE345865	2
7	850117	EE375785	2
8	850204	EE200945	2
9	850308	EF215105	2

* UTM LOCATIONS FOR MOUNTAIN LION M11
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	841021	483610	1
2	841022	487594	1
3	841027	504589	1
4	841028	509587	1
5	841030	484594	1
6	841105	565610	2
7	841106	563605	1
8	841107	563605	1
9	841108	555619	2
10	841110	580615	2
11	841112	576616	1
12	841113	549611	1
13	841114	546616	1
14	841115	546615	1
15	841116	535619	2
16	841117	523626	2
17	841118	502602	1
18	841126	470602	1
19	841127	502601	1
20	841206	555614	1
21	841209	530619	1
22	841210	546615	1
23	841211	546615	1
24	841212	541611	1
25	841213	539610	1
26	841214	533615	1
27	841215	546615	1
28	841219	503599	1
29	841221	478595	2
30	850103	472641	2

* UTM LOCATIONS FOR MOUNTAIN LION M12
ALL LOCATIONS ARE IN 100,000 METER SQUARE EF

	DATE	UTM LOCATION	TYPE
1	841111	332609	1
2	841113	328607	1
3	841114	298575	1
4	841115	285554	1
5	841116	291565	1
6	841203	277566	1
7	841217	284574	2
8	841221	272601	2

9	850103	283564	2
10	850110	259577	2
11	850117	264576	2
12	850129	314614	2
13	850210	332614	2
14	850211	335610	1
15	850213	324602	2
16	850226	288578	2
17	850301	302587	2
18	850308	335619	2
19	850309	310623	2
20	850321	291596	2
21	850327	334611	2
22	850405	313619	1
23	850419	334589	2
24	850430	336611	1
25	850501	335623	1
26	850505	323628	1
27	850506	343604	2
28	850508	332608	2
29	850515	295601	2
30	850519	310639	2
31	850520	310602	2
32	850522	340610	2
33	850529	309560	2
34	850609	294654	2
35	850619	342544	2
36	850623	302562	2
37	850629	364595	2

