THESIS

CHARACTERISTICS OF THE MOUNTAIN LION POPULATION NEAR CANON CITY, COLORADO

Submitted by

Mary Jean Pfile Currier

In partial fulfillment of the requirements

for the Degree of Master of Science

Colorado State University

Fort Collins, Colorado

Fall, 1976

ABSTRACT OF THESIS

CHARACTERISTICS OF THE MOUNTAIN LION POPULATION NEAR CANON CITY, COLORADO

A study was initiated in 1974 with the following objectives: (1) estimate the number of mountain lions in a specified geographic area of Colorado, and (2) gather data on the mountain lions. The study site selected for the first season (winter 1974-75) was situated between Canon City and Cripple Creek and covered approximately 900 km^2 (350 mi^2). The second segment of the study was carried out on a 1950 km^2 (750 mi^2) area between Canon City and Salida. Two mountain lions were marked and released on the study area during the first season. Seventeen mountain lions were marked and released on the expanded study area the second season, and three were subsequently retreed, for a total of 20 captures the second season. A total of 37 sets of lion tracks were recorded on the study area the first season. An analysis of these tracks led to a population estimate of between 15 and 25 mountain lions, or one lion per 36 to 60 km^2 (14 to 23 mi^2). A total of 135 sets of lion tracks were recorded on the study area during the second season. An analysis of the captures and tracks from the second season resulted in an estimate of 35 to 65 mountain lions, or one

lion per 30 to 56 km^2 (12 to 21 mi^2). It was concluded that the statewide mountain lion population is probably larger than formerly estimated and that the lion population does not appear to be in danger of being over-harvested.

Mary Jean Pfile Currier
Department of Fishery and
Wildlife Biology
Colorado State University
Fort Collins, Colorado 80523
Fall, 1976

ACKNOWLEDGEMENTS

I would like to thank my husband, Gray Currier, for taking most of the photographs of the study, for carrying half of the equipment during the second season, and for proofreading and typing my thesis. I would also like to thank my Adviser, Dr. Kenneth Russell, for the time he spent helping me with the study. I am grateful to the other committee members, Mr. Raymond Boyd, Dr. Lester Fraley, and Dr. Julius Nagy, for their helpful suggestions. I also appreciate the comments of Dr. Douglas Gilbert.

This study would not have been possible without Mr. Robert Tully, of the Colorado Division of Wildlife, or ranchers on the study areas who allowed us to hunt on their land. I would especially like to thank Mr. and Mrs. Ed Grainger, and Mr. and Mrs. Harold Lovelady for allowing us to establish base camps on their land. The help of Bob Peters, Don Justman, and the W.C.O.'s is also appreciated.

I would like to thank Marilyn Stevens, of the Colorado Division of Wildlife, for determining the ages and physical condition of the lion-killed deer.

Finally, I would like to thank the agencies which funded my project: Colorado Division of Wildlife, Colorado State University, U. S. Fish and Wildlife Service, The Wildlife Management Institute, and Game Conservation International.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Felis concolor, commonly called mountain lion, cougar, or puma, probably has the most widespread distribution of any native land mammal in the Western Hemisphere. The mountain lion ranges from southern Argentina and Chile to British Columbia (Young and Goldman 1946:177), almost one hundred degrees of latitude. The adaptability of this large feline is due mainly to its capability as a hunter and its general diet. The main limitation to its distribution, aside from human interference, seems to be lack of necessary stalking cover (Nowak 1976:1).

The mountain lion has long been a subject of controversy. The early settlers of North America considered the mountain lion to be a threat to themselves and to their livestock. Their fears for their own safety on this account were largely unfounded. Only six authenticated reports of human deaths due to mountain lions in the U.S. and Canada are on record for the twentieth century (Nowak 1976:151). One, a woman, probably died of rabies, as did a boy. Two other boys were killed by lions that, when killed, were found to be in advanced stages of starvation. Two young boys were attacked by apparently healthy animals. The settlers' concern for the safety of their livestock from mountain lion attack was valid mainly in the southwest.

Only in that area, except for isolated instances, did stomach content analyses of mountain lions reveal a significant portion of domestic stock (Young and Goldman 1946:128). Nonetheless, public sentiment generally ran high against the mountain lion until fairly recently, as evidenced by the opening statement in a California Fish and Game article: "The one predatory animal for which practically no good can be said is the mountain lion." (Hunter 1921:99).

Mountain lions were also considered detrimental to big game. For that reason they were hunted to near extermination from Yellowstone National Park by 1914 and from the Kaibab Plateau in Arizona by 1931 (Weddle 1966). Hornocker (1970:36) proposed a theory to the contrary, that mountain lions are actually beneficial to big game populations: "Lions have been shown to force the redistribution of elk and deer on limited winter range. This is doubly important to ungulate species exhibiting weak or nonterritorial behavior which allows them to overpopulate an area and seriously damage the habitat."

Fear and hate of the mountain lion were prevalent in Colorado when the state legislature passed an act in 1881 which encouraged the destruction of mountain lions and authorized a payment of $10 for each lion killed. This act was repealed in 1885. In 1919 money was set aside from both state and federal sources to help rid the state of predatory animals. In 1921 the General Assembly defined "predatory animals" as wolves, coyotes, and mountain lions. A bounty

of $25 per adult lion and $10 per kitten was established in 1920 by the Denver Post and was continued until 1939 (Dixon and Boyd 1967). The state established a bounty of $50 per lion in 1929. This bounty was discontinued in 1965, when Colorado became the second western state to declare the mountain lion a big game animal and The Wildlife Commission established the first season for hunting the mountain lion (Nowak 1976:80).

When the mountain lion was declared a big game species, responsibility for its management was delegated to the Colorado Division of Wildlife. In order to determine a sound management policy, it is essential to evaluate the impact of hunting on a population. Therefore, an initial appraisal was carried out as follows. A study was begun in 1966 to evaluate the effects of mountain lion predation. Bounty records were examined, as were several deer believed to have been killed by lions. The initial minimum population estimate based on the kill records was 124 (Dixon and Boyd 1967). In 1970 a questionnaire was sent to selected Colorado guide-and-outfitters, and another questionnaire was sent to all the Wildlife Conservation Officers. A compilation of these questionnaires resulted in a known population of 276, with a minimum estimate of 406 and a maximum estimate of 769 (Myers 1972, unpublished report, Div. of Game, Fish and Parks, Colorado). A map indicating high, medium, and low densities of mountain lions was drawn from questionnaire information (Sandfort and Tully 1971). The

preseason population was estimated to be 800 from 1968-72, with a goal of 1000 to be reached by 1980 (Colorado Division of Wildlife 1974:27). Further evaluation could be accomplished by a periodic head count, by utilization of reproductive and mortality rate data to ascertain whether animals are being added to a population at a higher rate than they are being removed, or by an intensive study within a limited geographic area that could later be more broadly applied to the state as a whole. The last approach was adopted as the next step in the evaluation process. The study undertaken is the subject of this thesis.

The study was initiated in 1974 with the following objectives:

(1) Estimate the number of mountain lions in a specified geographic area of Colorado;

(2) Gather data on individual mountain lions.

The hypothesis tested was: there is at least one mountain lion per 60 km^2 (23 mi^2) on the study area chosen.

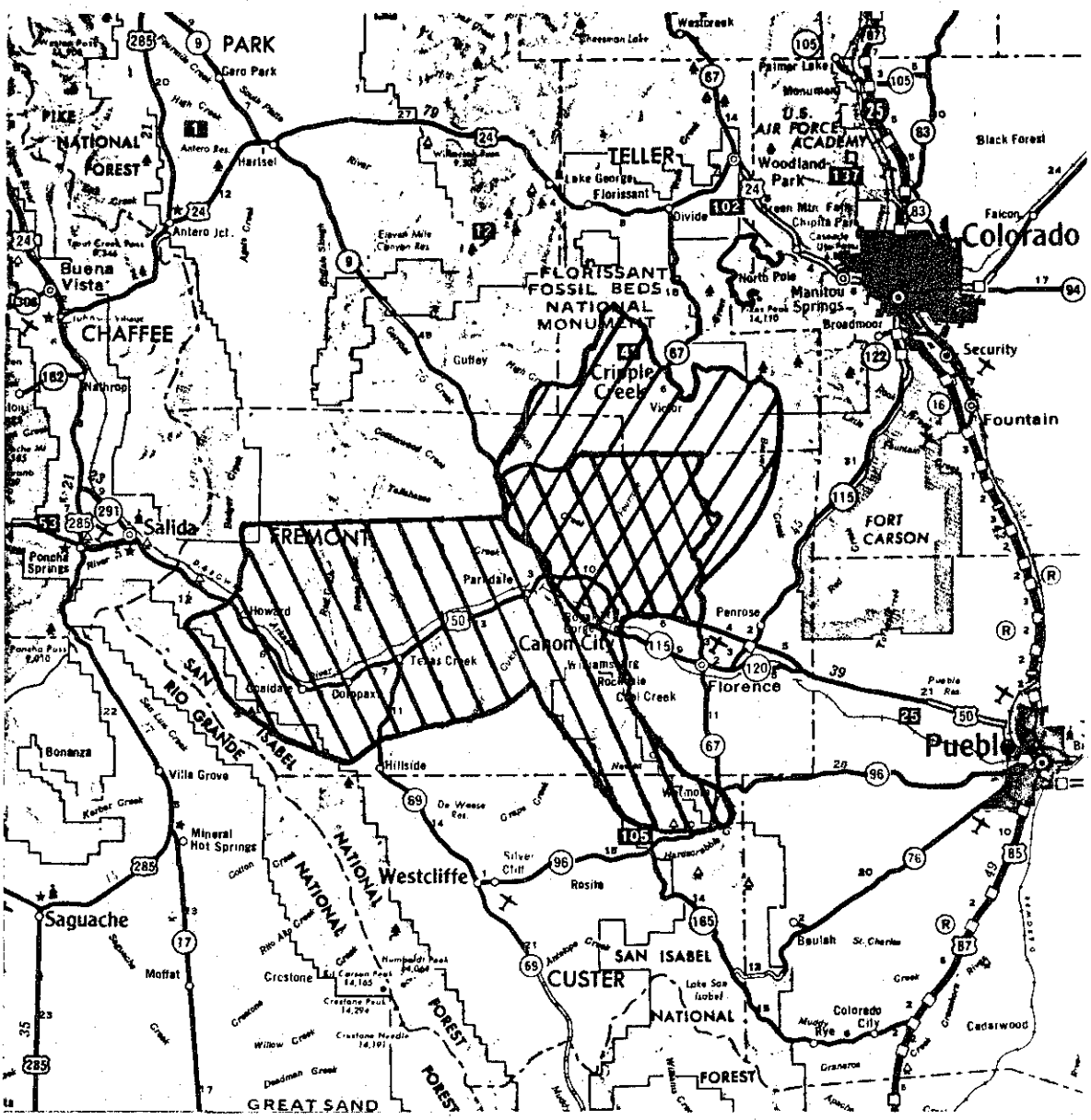
The first study season was from 9 December 1974 to 26 March 1975. The second season was from 18 December 1975 to 6 May 1976. The third and final season will be carried out by another graduate student, Steven L. Sheriff, during the winter of 1976-77.

STUDY AREAS

Four suitable study areas recommended by various individuals were selected by the Colorado Division of Wildlife in the fall of 1974 for final consideration. Two were on the Western Slope (Roan Creek north of Grand Junction; the Douglas Mountain area south of Rangely), and two were on the Eastern Slope (north of Canon City; west of Trinidad). All were reported to support high-density mountain lion populations (Myers 1972, unpublished report, Div. of Game, Fish and Parks, Colorado). The amount of hunting activity, characteristic snowfall pattern, and amount of public and private property in each unit were given consideration before final selection of the study area was made.

The study site selected for the first season (winter 1974-75) was situated between Canon City and Cripple Creek and covered approximately 900 km^2 (350 mi^2) (Fig. 1). The terrain was rough and mountainous, ranging in elevation from about 1600 m (5300 ft) to about 3000 m (9700 ft). Most of the area was above 2000 m (6500 ft).

We met with limited success in capturing mountain lions the first season, probably due to a combination of factors. Much of the area hunted was high in elevation, so although ranchers saw a lot of lion sign when rounding up their cattle during the fall, heavy snowfall in December



Key:

4.2 cm = 40 km (25 mi)

= study area for the first season (winter 1974-75)

= study area for the second season (winter 1975-76)

Figure 1. Study areas near Canon City, Colorado.

probably drove both the deer and lions down for the rest of the winter. Due in part to the elevation, we encountered much wind, which obscured tracks and made it difficult to follow the dogs, as well as the mountain lions. Houndsmen were changed well into the season, so each had to separately become familiar with the area. The dog that had the best sense of smell and was the best dry-ground dog was kicked by a horse and had a leg broken in late January, rendering it unuseable the rest of the season.

After extensive discussions, it was decided to enlarge the study area for the second season (winter 1975-76) by adding three more units of roughly comparable size. The increased study area was surveyed by the research team, and sites that appeared to be prime mountain lion habitat, as judged by the presence of mountain lion scrapes and tracks, were selected in which to concentrate hunting. The second segment of the study was carried out on a 1950 km^2 (750 mi^2) area between Canon City and Salida along the Arkansas River (Fig. 1). It, too, was rough, mountainous terrain, ranging in elevation from about 1600 m (5300 ft) to about 3000 m (9700 ft).

Both sites were relatively arid, with an average annual precipitation of about 35.5 cm (14 in) (National Oceanic and Atmospheric Administration 1974-76). They were covered mainly by pinyon-juniper woodlands at the lower elevations and pine-Douglas fir forests at the upper elevations. The dominant trees were pinyon (Pinus edulis), Ponderosa pine

(*Pinus ponderosa*), and Douglas fir (*Pseudotsuga menziesii*). The most common shrubs were juniper (*Juniperus communis*, *J. monosperma*, and *J. scopulum*), oakbrush (*Quercus gambellii*, *Q. turbinella*, and *Q. undulata*), and cholla and prickly pear cactus (*Opuntia imbricata* and *O. polycantha*).

METHODS

Two trailers were set up for field camps. The first season they were located in Victor on Mr. and Mrs. Ed Grainger's land, and the second season they were located on the ranch of the Harold Lovelady's, of Eight Mile Park, west of Canon City.

Houndsmen

A houndsman and his trained dogs were employed to tree the mountain lions. Ray Lyons, of Collbran, was the houndsman for the first 12 field days of the first season (winter 1974-75). He withdrew from the project because of illness, and Joe Pecharich, of Paonia, was asked to replace him. Mr. Pecharich was the houndsman for the last 60 field days of the first season. Chuck Anderson, of Louviers, was retained by the Division as houndsman for the second season (winter 1975-76).

None of the houndsmen had ever hunted in either of the study areas, so it was necessary to rely upon the judgement of local people as to which were the good units in which to look for lion sign. After becoming familiar with the area, we tried to spend roughly the same amount of time in each unit of the study area, while still making use of snow cover and known lion activity.

Before hunting on any land, permission was first obtained from the landowner, and the program was explained to him or her (Appendix A).

The majority of the first season was spent looking for lion tracks from horseback, while the majority of the second season was spent looking for lion tracks from a truck (the preference of each houndsman was followed).

The hunt

The basic procedures after a lion track was encountered were the same. The age of the track was estimated, and the size of the track (small, medium, or large for the first season, and the length and width of the hind pad and stride length for the second season) and the direction of travel were recorded. If the dogs could follow the track, they were pointed in the right direction and turned loose. Sometimes, if the track was very fresh, the dogs were turned loose before I could measure the track.

We would then follow the dogs as quickly as possible, on horseback the first season, and afoot the second season. The second season, the 24 kg (52 lb) of equipment (Fig. 2) were carried in backpacks by me and my husband, Gray Currier.

After the dogs treed the lion (Figs. 3 and 4), they were held or tied up (Fig. 5). The location of the tree, the type of vegetation around the tree, and the snow depth at the tree were recorded. I estimated the lion's weight,

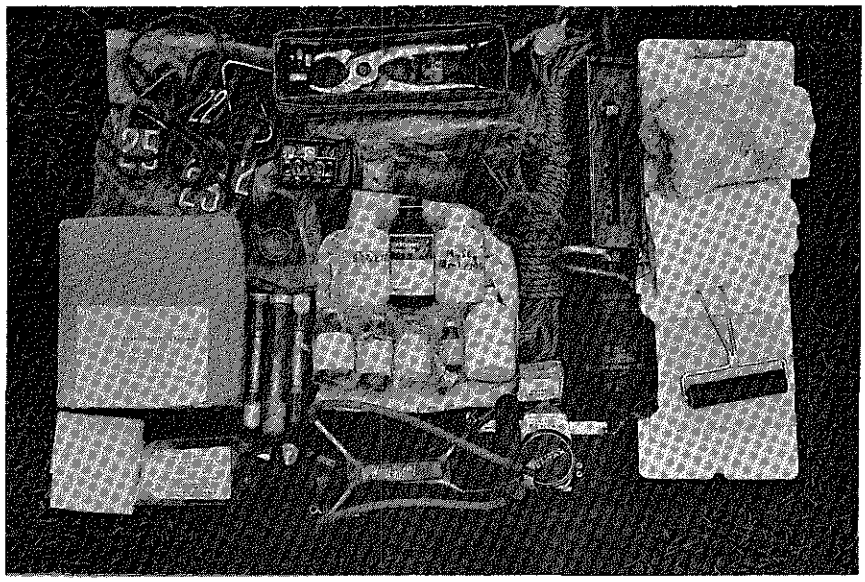


Figure 2. Equipment carried during second season.

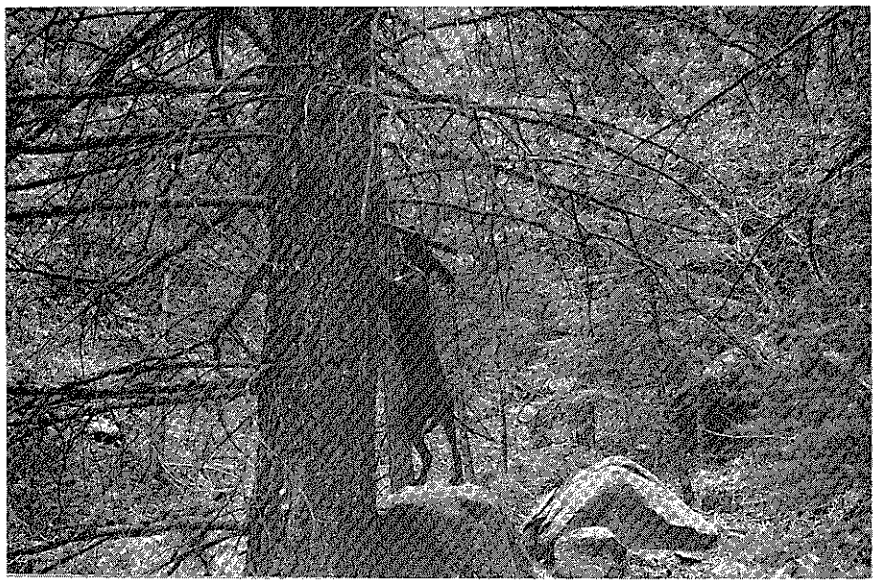


Figure 3. Hound barking "treed".

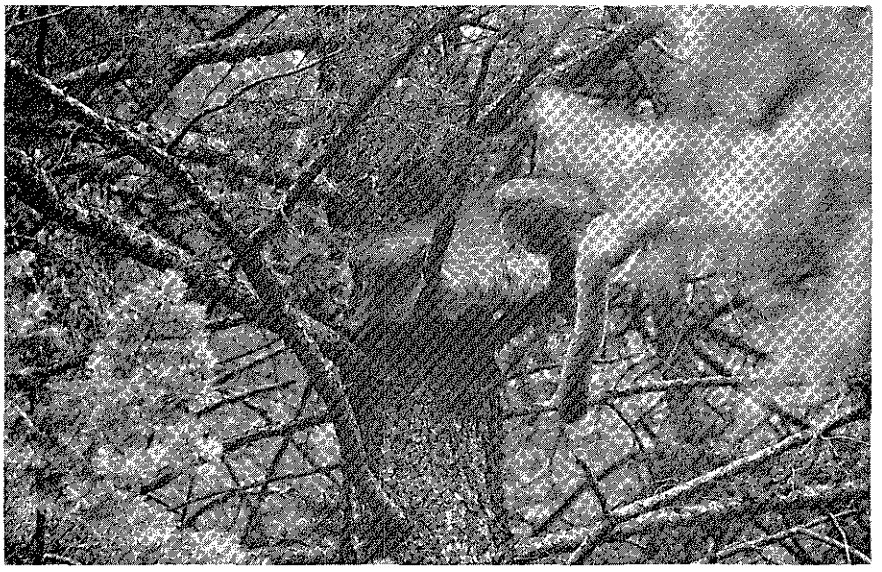


Figure 4. Lion in tree.

Figure 5. Holding dogs after lion has been treed.

prepared a dart with a drug dose corresponding to that weight, and darted the lion with conventional immobilizing equipment (Fig. 6). This equipment consisted of a Cap-chur gun[1] (a powder-charged rifle) and a drug-filled dart fired by a cartridge-type detonator. The lion was encouraged to leave the tree and was followed with the dogs on leashes.

The drug used was "CI-744", an experimental drug[2]. The drug is a combination of tiletamine hydrochloride and zolazepam. Tiletamine is a phencyclidine derivative that selectively interrupts sensory and pain input to the brain. Zolazepam is a tranquilizing agent. This combination has a minimal effect on pharyngeal and laryngeal reflexes, so if the animal salivates excessively, it can swallow (Eads 1976).

The tranquilized lion was located, sometimes having traveled as far as 2-3 km (1-2 mi) before succumbing to the drug. A nylon rope collar with a red numbered tag was placed around the lion's neck, and the tag's number was tattooed in both ears. Weight (Fig. 7), body measurements (Appendix B and Fig. 8), and hair and blood samples were taken for later interpretation after an aging technique has been devised.

The age of the mountain lion was estimated on the basis of tooth wear and general appearance of the animal.

---

[1]Palmer Chemical and Equipment Co., Douglasville, Georgia.

[2]Parke-Davis and Co., Detroit, Michigan.

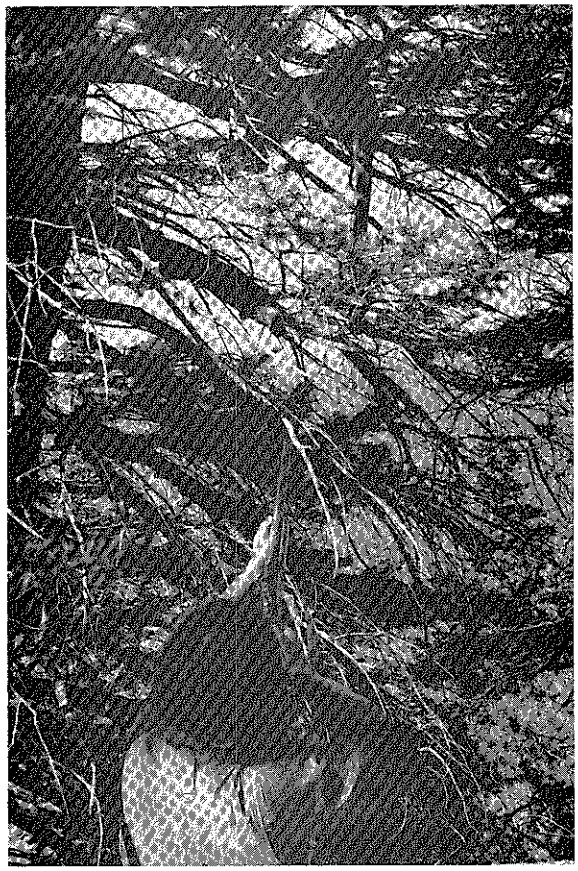


Figure 6. Taking aim at lion in tree.

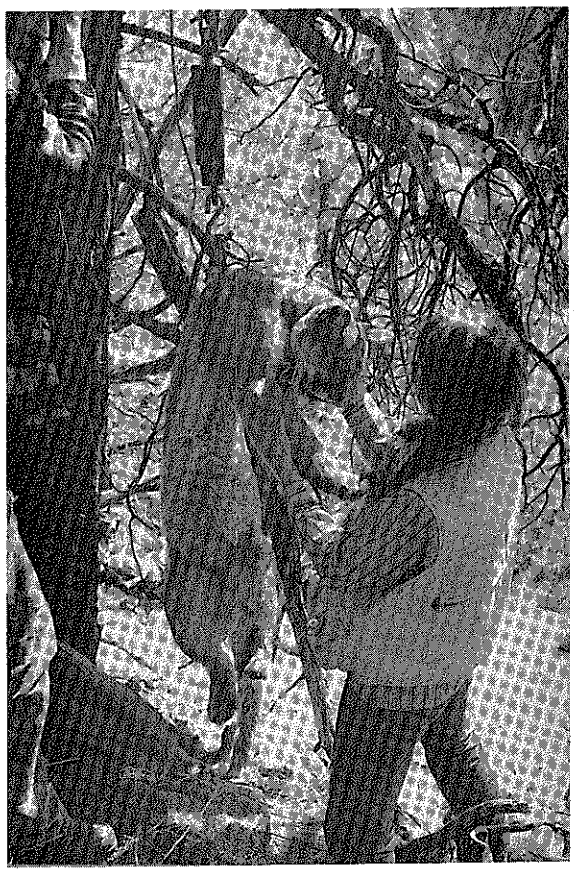


Figure 7. Lion suspended from spring scale.

Figure 8. Measuring skull arch.

The animal was classified as an adult (full grown, probably 3 or more years old), adolescent (still retaining at least one spot - often the last to go is the spot under the foreleg - probably 2-3 years old), or kitten (many spots, smaller size, probably less than 2 years old).

As soon as the lion could move in a fairly controlled manner or was in no danger from rolling down the hill, it was released.

Mountain lion kills

We occasionally found a carcass of an animal that was apparently killed by a mountain lion. A kill made by a lion can be recognized by its location (usually in a gully or some protected place, rarely in the open) and the manner of kill (tooth marks on the neck and usually a broken neck). It is often covered with pine needles, dirt, or branches. If a carcass met these criteria, a long bone, usually the femur or tibia, was collected for evaluation of the physical condition of the animal, and the lower jaw was collected for determining the age of the animal. The second season, these criteria were more stringently applied than the first season, so only data from fresh kills in good enough condition to determine the manner of kill were recorded.

Population estimation

The locations of the lions captured and all of the track records were plotted on a map and analyzed according

to size, age, location, and direction of travel of the track. Each capture or set of tracks was assigned to one of three categories. Definitely recognizable individuals (count X) were first sorted out. (For instance, the lions caught were known to be different individuals). If the tracks in a given area were very similar in size and direction of travel, and if they were of ages harmonious with the cyclical nature of a lion's traveling habits, they were judged to have probably been made by the same individual (count Y; this count also includes the single sets of tracks that are not paired with any other set). If the tracks were only similar in several respects, they were judged to have possibly been made by the same individual (count Z). This analysis resulted in a minimum estimate (count X only), a likely estimate (count X plus count Y plus count Z), a moderately possible estimate (count Z is assumed not to have been made by the same individual, so the estimate is equal to count X plus count Y plus two times count Z), and a maximum estimate (all of the tracks are assumed to have been made by different individuals).

The tracks were also divided into kitten (small, with a pad size about 3 cm length by 4 cm width or smaller, probably representing animals less than a year old) and nonkitten (medium to large size, probably representing animals more than a year old).

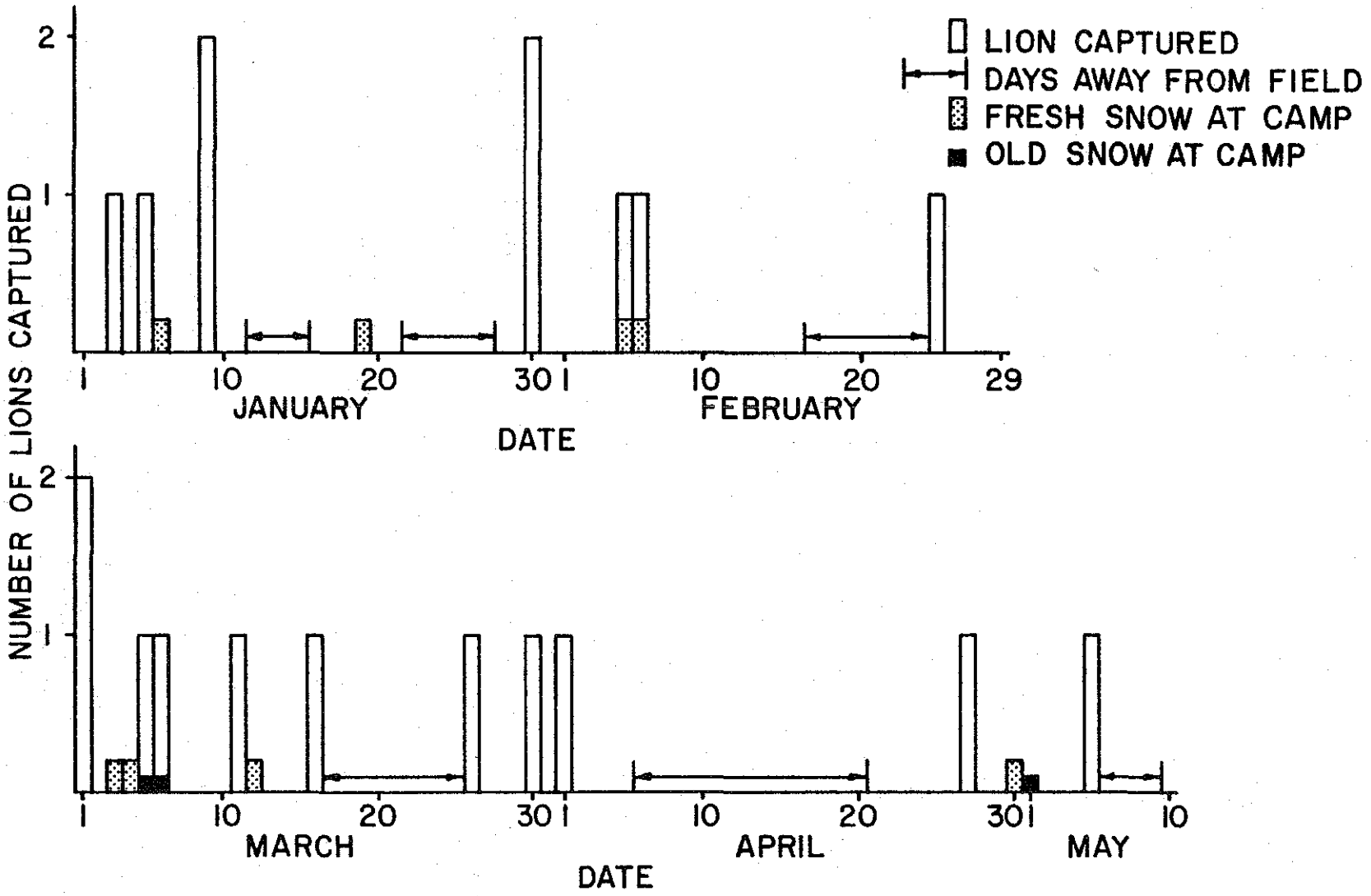
RESULTS

Field conditions

A total of 72 days were spent in the field the first season, and 95 days the second season. Fifty-four days were spent hunting the first season, and 68 days the second season. Ten and 11 days, respectively, were spent traveling to and from the study areas. Eight and 17 days, respectively, were spent not hunting, due to unfavorable weather conditions, due to the necessity of contacting land owners, or due to other detainments. The days spent hunting during the second season were subjectively rated according to tracking conditions: one day was excellent, four days were good, 30 days were fair, and 33 days were poor. Precipitation at the Canon City weather station during December 1974 was 255 percent of the average amount for that month, while that for January-March 1975 was 77 percent of the normal amount. Precipitation from December 1975-April 1976 was 44 percent of the average amount (National Oceanic and Atmospheric Administration 1974-76). (Fig. 9 shows days of snow at the base camp the second season).

During the first season the dogs were able to follow 13 tracks for some distance, but only one track was fresh enough for them to tree a lion. The second season the dogs could follow 32 tracks, and treed a lion from 20 of them.

Figure 9. Dates of mountain lion captures and snowfall during the second season (winter 1975-76).


LION CAPTURED
DAYS AWAY FROM FIELD
FRESH SNOW AT CAMP
OLD SNOW AT CAMP
NUMBER OF LIONS CAPTURED
2
1
1
10
20
30
1
10
20
29
JANUARY
FEBRUARY
DATE
2
1
1
10
20
30
1
10
20
30
1
10
MARCH
APRIL
MAY
DATE

Approximately 640 km (400 mi) were traveled on horseback or on foot looking for lion tracks the first season. Approximately 420 km (260 mi) were traveled on foot and about 1600 km (1000 mi) in vehicles looking for lion tracks during the second season.

Mountain lions captured

Two lions were marked and released on the study area during the first season. One was a young male that had been caught in a bobcat trap, and one was a female that was brought to bay on a rock. (Appendix C describes each capture in detail). One capture was made with dogs in the 54 days of hunting.

Seventeen mountain lions were marked and released on the (expanded) study area the second season, and three were subsequently retreed, for a total of 20 captures (Appendix C and Fig. 9). The average amount of time required to capture a lion was 3.4 days of hunting. A female lion and her kitten were captured before the beginning of the second season, about 50 km (30 mi) south of the study area. The female was marked and released, but the kitten died from injuries inflicted by the dogs.

Seven lions captured on the study area the second season were male, and ten were female. Three of the males were judged to be adult and weighed 66, 68, and 70 kg (145, 150, and 155 lb); two were judged to be adolescent and weighed 54 and 57 kg (120 and 125 lb); two were kittens and weighed 10

and 11 kg (22 and 25 lb). Seven of the females were judged to be adult and weighed from 36 to 45 kg (80 to 100 lb), with an average weight of 41 kg (91.5 lb); three were judged to be adolescent and weighed 34, 34, and 36 kg (75, 75, and 80 lb). The adult:adolescent:kitten ratio was judged to be 10:5:2 (1.0:0.5:0.2). Therefore, 59 percent of the lions captured were classified as adults.

Fetuses could be felt in only one female (No. 21) during the second season. None of the females showed signs of lactation, although one (No. 11) showed signs of having lactated up until a few months earlier. An adolescent female (No. 10) was still traveling with her mother (No. 9). Therefore, only 43 percent of the adult females captured the second season (not including those judged to be adolescent and just entering the breeding population) were pregnant, had lactated recently, or had offspring traveling with them. The mother of the two kittens captured is not included in the calculation, because she was not captured and was probably dead. Four days before the kittens were captured, a hunter killed a female in the same area. She was probably the kittens' mother, because no sign of an adult was seen, either at the time of the initial capture of the kittens, or two weeks later when one of the kittens was recaptured.

Two of the adult males (No. 6 and No. 16) were tracked through exactly the same area and were captured within the same vicinity. Two adolescent males (No. 18 and No. 19) were captured in the same vicinity. Two kittens (No. 13 and

No. 14) were tracked together through the same area and were captured within the same vicinity.

The kitten (No. 14) was recaptured 15 days later, almost 3 km (2 mi) from the original capture site. The female (No. 15) was captured the second time 25 days later, 12 km (7.5 mi) away from the initial capture site. The male (No. 7) was recaptured 28 days later, 3.2 km (2 mi) from the original capture site.

Track analysis

A total of 37 sets of tracks were recorded on the study area during the first season, for an average of one set per 17.3 km (10.8 mi) covered. An analysis of these tracks led to a population estimate of 18 (likely) to 22 (possible) lions, including kittens, that might have been in residence or transients through the study area at some time during the winter (Table 1). The number of lions that actually inhabited the study area for some time that winter was probably between 15 and 25. If that number of lions actually inhabited the study area, then the population density was one lion per 36 to 60 km^2 (14 to 23 mi^2). Eleven lions were definitely recognizable from tracks or capture. One female was with a young kitten, and a pair of adults were traveling together (perhaps a female with a grown kitten). One individual was very large-footed, one was quite small-footed, and two lions were captured (neither were particularly large- or small-footed, or accompanied by another lion).

Table 1. Estimated numbers of mountain lions that made the tracks observed on the study area during the first season (winter 1974-75).

Vicinity	Minimum[1]	Likely[2]	Moderately possible[3]	Maximum possible[4]
Phantom Canyon (east)	7	7	8	12
Indian Springs (south)	3	5	6	9
Cover Mountain (west)	1	4	5	9
Cripple Creek (north)	0	2	3	5
Totals	11	18	22	35

Criteria for each category of estimate:

[1] Minimum - only recognizable individuals.

[2] Likely - no specific evidence was noted that indicated that the number of lions present was any fewer than the number of sets of tracks observed, after elimination of probable duplicate observations.

[3] Moderately possible - the likely estimate plus a judgement that certain sets of tracks possibly had been made by two lions rather than one.

[4] Maximum possible - assumes that all tracks observed were made by different individual lions.

A total of 135 sets of lion tracks were recorded on the study area during the second season, for an average of about one set per 15 km (9 mi) covered. An analysis of the captures and tracks resulted in a range of from 45 (likely) to 57 (possible) lions, including kittens, on the study area at some time during the 1975-76 winter (Table 2). Of the 45 judged to be probable individuals, 11, or 25 percent of the population, were kittens, based on track size. The number of lions that actually inhabited the study area at some time during the second season was probably between 35 and 65. If this is true, the population density was one lion per 30 to 56 km^2 (12 to 22 mi^2). The minimum estimate is 28 lions. Seventeen lions were tagged. Tracks of one female with three kittens, one female with two kittens, and two different females, each with one kitten, were found.

Mountain lion mortality

Four mountain lions were recorded by the Division as killed by hunters on the study area during the first season; all were males. During the second season, nine lions were reported killed on the (expanded) study area, with a male: female ratio of 6:3 (2:1). One kitten was killed by a car the second season, and a rancher found a dead mountain lion, its mouth full of porcupine quills, on the study area. No marked lions have been recovered, to my knowledge, as of 1 November 1976.

Table 2. Estimated numbers of mountain lions that made the tracks observed on the study area during the second season (winter 1975-76).

Vicinity	Minimum[1]	Likely[2]	Moderately possible[3]	Maximum possible[4]
Parkdale	1	3	4	6
Dilly-Thorson	2	4	6	21
Like-Willis	10	12	16	36
Texas Creek-Cotopaxi	5	7	9	23
Cottonwood Creek-Howard Creek	7	13	15	40
Oak Creek Grade	3	6	7	9
Totals	28	45	57	135

Criteria for each category of estimate:

[1] Minimum - only recognizable individuals.

[2] Likely - no specific evidence was noted that indicated that the number of lions present was any fewer than the number of sets of tracks observed, after elimination of probable duplicate observations.

[3] Moderately possible - the likely estimate plus a judgement that certain sets of tracks possibly had been made by two lions rather than one.

[4] Maximum possible - assumes that all tracks observed were made by different lions.

Mountain lion kills

Five of the deer carcasses found by the research team during the first season were believed to have been killed by mountain lions within the preceding six-month period. Two were males ages 2-3 and 3-4 years, one was a female 1-2 years old and the ages of the two deer of unknown sex were 3-4 years and over 7 years. The fat content in the marrow of the three long bones that were not dried up exceeded 90 percent in each sample.

Four of the deer carcasses found by the research team during the second season were believed to have been killed by mountain lions two weeks or less before their discovery. Two were bucks, aged 3 years and about 9 years, and two were does, aged 3 years and 5 years. The fat content of the long-bone marrow was above 90 percent for all except the 9-year-old buck. The marrow of his long bone was 83 percent fat. His hind foot was badly cut and swollen, probably as a result of becoming entangled in barbed wire or the like, a few weeks earlier. The lion marked on 25 November 1975 outside the study area had killed an elk, but neither jaw nor long bone were collected from the kill.

Capture site conditions

A breakdown of the vegetational types, capture locations, and snow depth at the capture sites during the second study season is as follows: pinyon-juniper-Ponderosa pine, 25 percent; pinyon-juniper-Douglas fir, 25 percent;

Ponderosa pine-lodgepole pine, 15 percent; Douglas fir, 10 percent; pinyon-juniper-aspen, spruce-Ponderosa pine, pinyon-juniper-Ponderosa pine-Douglas fir, lodgepole pine, and Ponderosa pine, each 5 percent. Forty percent of the lions were treed on the upper third of a ridge, 30 percent on the middle third, 10 percent on a ridge top, and 5 percent on each of the following: canyon floor, lower third of a ridge, draw, and several locations (lion No. 20 was treed and darted three times before we could handle her).

One lion was captured at an elevation between 1500-1800 m (5000-5900 ft), one between 1800-2100 m (6000-6900 ft), nine between 2100-2400 m (7000-7900 ft), eight between 2400-2700 m (8000-8900 ft), and three above 2700 m (9000 ft).

Twenty-three shots were fired during the second season. Of the 23, three were missed; the first was too low because the gun had not been sighted in, another missed because the lion was moving in the tree, and a third missed because the powder charge was faulty and was barely sufficient to push the dart out of the gun. Therefore, 87 percent of the shots were classified as "hits". Fifteen struck the lion in the hip or hind leg, four in the shoulder or front leg, and one in the thoracic region. Two detonator charges didn't fire. Two darts were lost: one was buried in the snow after a lion fell out of the tree, and one came out while a lion was running through some brush.

Of the 19 individuals captured on the study areas, the weights of 13 were underestimated by an average of 6.8 kg (15 lb), with a range of 2.3-18 kg (5-40 lb), and the weights of 6 were overestimated by an average of 9 kg (20 lb), with a range of 2.3-25 kg (5-55 lb).

DISCUSSION

The study presented here allows only tentative conclusions to be drawn, due to the limited size of the study areas, the relatively short (two season) duration of the study, the small sample size, and the fact that a different area was utilized each season.

The population estimates of one lion per 36 to 60 km^2 for the first season and study area, and one lion per 30 to 56 km^2 for the second study season and area are based on an analysis of the captures and tracks recorded. Three possible sources of error in the estimate are: there may have been additional but undetected duplicates in the tracks judged to have been made by different individuals, some of the tracks judged to have been made by the same lion could have been made by different lions, and there may have been additional lions in the study area whose tracks were not observed. A verification of my method of population estimation will hopefully be available after the final season, winter 1976-77. The study during the third season will be conducted in the same area as the second season, so both the track method of population estimation and a ratio of marked:unmarked individuals can be used to estimate the population.

The mountain lion population in a given area has been studied in several other western states (Ashman 1975, Job Performance Rep., Proj. W-48-6, Nevada Dept. Fish and Game; Donaldson 1975, Hornocker 1970, Seidensticker et al. 1973, Shaw 1976, and Sitton et al. 1976, P-R Job Prog. Rep., Proj. W-51-R, California Dept. Fish and Game). The estimation of a mountain lion population on a 450 km^2 (175 mi^2) area halfway between San Francisco and Los Angeles in California was 16-20 lions, or one lion every 23-28.5 km^2 (8.8-11 mi^2) (Sitton et al. 1976, P-R Job Prog. Rep., Proj. W-51-R, California Dept. Fish and Game). Shaw (1976) estimated the population of mountain lions on the Spider and Cross U Ranches, 550 km^2 (210 mi^2), north and west of Prescott, Arizona, to be from 16 to 24, or one lion every 23-34.5 km^2 (8.8-13.3 mi^2). The average number of lions per year over a five-year study period on the 520 km^2 (200 mi^2) central Idaho area studied by Hornocker (1970) was 14.6, or one lion every 35.5 km^2 (14 mi^2). Three different areas were studied in Nevada (Ashman 1975, Job. Perf. Rep., Proj. W-48-6, Nevada Dept. Fish and Game). The highest density estimate was calculated for the 775 km^2 (300 mi^2) area in the Cherry Creek Range: 7-8 lions, or one per 99-111 km^2 (37.5-43 mi^2). The next highest mountain lion density estimate was calculated for the 1800 km^2 (700 mi^2) Ruby Mountain area: 10-12 lions, or one lion per 150-180 km^2 (58-70 mi^2). The lowest mountain lion density estimate was calculated for the 1675 km^2 (650 mi^2) area in the Snake

Range: 5-9 lions, or one lion per 186-335 km^2 (72-130 mi^2). The population estimate for the 68500 km^2 (26500 mi^2) study area in New Mexico was 493-636, or one lion every 107-139 km^2 (41.5-99 mi^2) (Donaldson 1975). (Table 3).

The estimate made by Hornocker (1970) was probably the most accurate, because he had essentially the whole population marked and/or radio-collared. Sitton et al. (1976, P-R Job Prog. Rep., Proj. W-51-R, California Dept. Fish and Game) also radio-collared most of the population on the California study area, but they believed there were still some untagged members of the population at large. Shaw (1976) also reported radio-collaring part of the lion population on the Arizona study area and based his population estimate on the capture data (minimum estimate) plus other individuals he believed are there. The Nevada estimates are based on lion captures plus others, but the method of determining the additional animals is not mentioned (Ashman 1975, Job Perf. Rep., Proj. W-48-6, Nevada Dept. Fish and Game). The method used in New Mexico (Donaldson 1975) differed from the basic method used to estimate the population in the above mentioned states: the 68500 km^2 study area was divided into 22 units of varying size based on historical lion activity, each assumed to have the same number of lions. Eight of these units were randomly selected for study, and of these eight, one for intensive study. One population estimate was based on captures and tracks in the intensively studied area (similar to the method in my study), then related to the

Table 3. Recent population estimates of mountain lions from studies of various western states.

State	Study area size (km^2)	Population estimate	Km^2 per lion	Authority
California	450	16-20	23-28.5	Sitton et al. 1976
Arizona	550	16-24	23-34.5	Shaw 1976
Idaho	520	14.6	35.5	Hornocker 1970
Colorado	1950	35-65	30-56	my study
Colorado	900	15-25	36-60	my study
Nevada	775	7-8	99-111	Ashman 1975
New Mexico	68500	493-636	107-139	Donaldson 1975
Nevada	1800	10-12	150-180	Ashman 1975
Nevada	1675	5-9	186-335	Ashman 1975

other seven units and extrapolated to the whole 68500 km^2 area. Another estimate was based on scrape stations as indicators of tracks, which, in turn, were indicators of lion numbers.

Only Hornocker (1970), Ashman (1975, Job Perf. Rep., Proj. W-48-6, Nevada Dept. Fish and Game), and Donaldson (1975) mentioned the number of days spent hunting and the number of lions caught. In our first season, we had the slowest rate: one lion per 54 days of hunting. The research team in New Mexico averaged one lion per 8.7 days of hunting (Donaldson 1975). The research team in Nevada averaged one lion per 6.0 days of hunting (Ashman 1975, Job Perf. Rep., Proj. W-48-6, Nevada Dept. Fish and Game). Hornocker (1970) and his group in Idaho averaged one lion per 4.3 days of hunting. The second season we averaged one lion per 3.4 days of hunting.

The sex ratio of the lions marked on the study area for the second season in my study was 7 males:10 females (0.7:1.0). In the California study, the ratio was 9 males: 5 females (1.8:1.0) (Sitton et al. 1976, P-R Job Prog. Rep., Proj. W-51-R, California Dept. Fish and Game). The explanation given for this finding in California was that the males travel more and are more likely to be caught. If this is true, this could indicate that the portion of males on the Colorado study area was even lower than indicated by the capture ratio. Perhaps the reason for the lower portion of males in my study area is that hunters tend to prefer males,

which are generally larger and of more value as trophies. For example, of the 13 lions killed by hunters on my study area during the study, 10 were males. The portion of males captured from unhunted populations (California, due to the moratorium on mountain lion hunting before and during the study, and Idaho, due to the location of the study area in an unhunted primitive area) tended to be higher than the portion of males captured from hunted populations (Colorado, Arizona, New Mexico, and Nevada). The differences in the percentages of male lions captured are presented in Table 4.

It is difficult to compare some of the aspects of the data from the various studies, due to the different methods of collecting and reporting data. The Idaho study area was the most intensely studied (Hornocker 1969, Hornocker 1970, Seidensticker et al. 1973). Data from that area were used to compare the percentage of kittens less than 12 months old with the kitten track information from my study. Data from my study yielded an estimate of 25 percent kittens. This is comparable with Hornocker's study (1970), which reported 27 percent of the population were kittens less than 12 months old.

Litter size is an important parameter. The differences in litter sizes are shown in Table 5. The litter size probably reflects a combination of the physical condition of the reproductive females, the mountain lion density, the climate, and perhaps the genetic pool. There is evidence from both Idaho (Hornocker 1970) and Nevada (Ashman 1975,

Table 4. Percentage of males in unhunted versus hunted populations in various western states.

State	Unhunted	Hunted	Number of males	Number of females	% males	Authority
California	X		9	5	64	Sitton et al. 1976
Idaho	X		20	19	51	Hornocker 1970
Idaho	X		28*	26*	52	Seidenstickker et al. 1973
Colorado		X	7	10	41	my study
Arizona		X	6	10	38	Shaw 1976
New Mexico		X	9	20	31	Donaldson 1975
Nevada		X	4	3	57	Ashman 1975

*These figures include those of Hornocker's (1970) study.

Table 5. Litter sizes of mountain lions.

State	Kittens per litter	Number of litters	Number of kittens	Average litter size	Authority
Colorado	1	4	4		my study
	2	3	6		
	3	1	3		
		Total	13	1.6	
California	1	2	2		Sitton et al. 1976
	3	2	6		
		Total	8	2.0	
Arizona	1	1	1		Shaw 1976
	2	2	4		
	3	2	6		
		Total	11	2.2	
Idaho	2	4	8		Hornocker 1970
	3	5	15		
	2	2	4		Seidensticker et al. 1973
	3	2	6		
		Total	33	2.4	
Washington (lions in captivity)			92	2.6	Eaton and Verlander 1976
Nevada			17	3.4	Ashman 1975

Job Perf. Rep., Proj. W-48-6, Nevada Dept. Fish and Game) that kitten mortality is high during the first year. Of the 23 kittens produced on the Idaho study area over a five-year period, two were killed by a mature male, three were killed directly by a hunter, three were killed by dogs, one was killed when the dart from the Cap-chur gun punctured its lung, and three 6-month-old kittens and three approximately 8-month-old kittens probably died after their mothers were killed by hunters (Hornocker 1970). Total production during the study in Nevada was at least 35 kittens. Total known mortality was 9 kittens, or about 26 percent (Ashman 1975, Job Perf. Rep., Proj. W-48-6, Nevada Dept. Fish and Game). Therefore, if the average litter size is 2.3 kittens (Table 5), and if one-third of them die before becoming reproductively active, probably one or two adolescents per reproductive female enter the adult population, approximately every two years.

Only 43 percent of the adult females captured during the second season appeared reproductively active. Perhaps other females had non-nursing kittens that weren't accompanying them at the time of their capture. All four of the females captured in the California study were accompanied by kittens (Sitton et al. 1976, P-R Job Prog. Rep., Proj. W-51-R, California Dept. Fish and Game). Hornocker (1970) reported that of the six resident females in the Idaho study area, five were reproductively active throughout most of the five years. Shaw (1976) reported that four of the nine

female lions captured were accompanied by kittens or were pregnant. The significance of these differences is not known, except that perhaps radio-collaring allows better observation of the animals and, therefore, increases the likelihood of finding evidence of kittens.

Donaldson (1975) in the New Mexico study recorded the vegetation type through which the recorded tracks were followed. More track sightings were reported for pinyon-juniper-Ponderosa pine areas (41 percent) than for any other vegetation type. In my study, vegetation types at the capture sited were recorded. Pinyon-juniper-Ponderosa pine and pinyon-juniper-Douglas fir were the two most frequent vegetation types in which lions were captured (25 percent each). No track sightings or captures occured in aspen alone.

The mountain lions in my study were generally captured at higher elevations than the lions in the Idaho study (Seidensticker et al. 1973). Eighty percent of the lions in my study were captured between 2100-2700 m, while 89 percent of the lions in the Idaho study were located between 1200-1800 m during January-May. This difference is probably partly due to the difference in snow depths. The average annual precipitation in the Idaho Primitive Area is 51-76 cm (Seidensticker et al. 1973), while for Canon City it is only 35.5 cm (National Oceanic and Atmospheric Administration 1974-76). The fact that the Idaho study area is of a latitude 8 degrees farther north than the Canon City study area probably also accounts for some of the difference.

All of the deer killed by lions found during both seasons of my study appeared to have been in satisfactory condition. There was no evidence to suggest that the very young or the very old deer were selectively taken, as was suggested by Hornocker (1970). Only 33 percent of the deer found were young (less than two years old) or old (more than seven years old). Hornocker (1970) found that 62.5 percent of the mule deer killed by lions on his study area were very young or very old. The sex-ratios of the lion-killed deer were fairly equal, 4 adult males:3 adult females, with two of unknown sex, but in the adult population as a whole, about 16 percent were males. (The actual count for the study area revealed 7 percent males, but the biologists in charge believed this figure was unrealistic). Although the sample size was small, the sex distribution of the adults in the kills is consistent with the mule deer data obtained in Idaho and Arizona. Hornocker (1970) found that 53 percent of the adult mule deer killed by mountain lions were males, while only 16 percent of the adult animals in the deer herd were males. Shaw (1976) found that 41 percent of the adult mule deer killed by lions were males, while only 17 percent of the adult deer in the herd were males. Hornocker (1970) suggested that this phenomenon might be due to the fact that bucks tend to winter at higher elevations than does and are often alone. Therefore, they are not as likely to detect an approaching mountain lion. Also, the bucks may tend to enter the winter in a weakened condition after the rut.

The mountain lion population near Canon City has historically been a fairly heavily hunted one. Of the mountain lions taken in Colorado from 1956 through 1965, 15 percent were reported as having come from Fremont County (Dixon and Boyd 1967). The study area represents about half of Fremont County. However, Fremont County represents only about four percent of the area of the 19 counties in which 97 percent of the lions were reported to have been killed. Fremont County is in an area of fairly high mountain lion density (Sandfort and Tully 1973) and is accessible to hunters. One of the most successful guide-and-outfitters in the state for mountain lion hunting conducts most of his hunts in the area.

The Colorado Cattlemen's Association is very active in Fremont County. Most of the land, whether public or private, on which the study was conducted in both the first and second seasons is grazed by cattle during the summer. The ranchers in the area tend to dislike coyotes above all, then mountain lions, and some also complain about the deer. Some of the ranchers expressed disdain for sheep raising, and during the entire study, we saw only four domestic sheep. Livestock practices are probably not going to change in the near future, nor will the prevailing enmity toward mountain lions be likely to change. This will favor the careful hunter, but not the careless one; though most ranchers dislike mountain lions, many dislike hunters who tear up the land and cut fences even more.

The statewide population of mountain lions has been estimated at 250-400 (Cahalane 1964). Dixon and Boyd (1965) used several methods to estimate the population. Using the average annual kill figure of 50, and assuming that 14-15 percent of the population is killed annually, the population estimate is 350. A more realistic way, they feel, is to use the formula $N = 3K + 3K/10$, where N is the minimum population and K is the annual kill (this formula assumes that it takes two lions to produce another one each year, and an equal sex ratio exists). Using this formula, the minimum population is 165 lions. Another estimate was made by interviewing several lion hunters in Mesa County, then using the estimate from Mesa County to obtain estimates of the populations in other counties, summing to a total of 142 lions for the state. A final estimate utilized kill figures averaged for each county over a five-year period and resulted in an estimate of 124 lions. A compilation of questionnaires sent to all W.C.O.'s and selected guide-and-outfitters in 1970 resulted in a population estimate of 406-769 (Myers 1972, unpublished report, Div. of Game, Fish and Parks, Colorado).

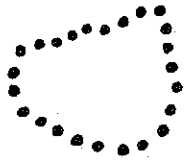
All of these population estimates are quite conservative, compared with findings of my study. If the population map representing high, medium, and low densities of mountain lions in Colorado (Sandfort and Tully 1971) is taken as a starting point, then superimposed over a potential climax vegetation map of Colorado (see Fig. 10), a more refined

Figure 10. Mountain lion density map (Sandfort and Tully 1971:76) superimposed on climax vegetation map (Kuechler 1973) of Colorado.

Key:


= high lion density area


= medium lion density area


= low lion density area


= non-tree climax

15 Western spruce-fir

18 Pine-Douglas fir

21 Southwestern spruce-fir

23 Juniper-pinyon

37 Mountain mahogany-oak

38 Great Basin sagebrush

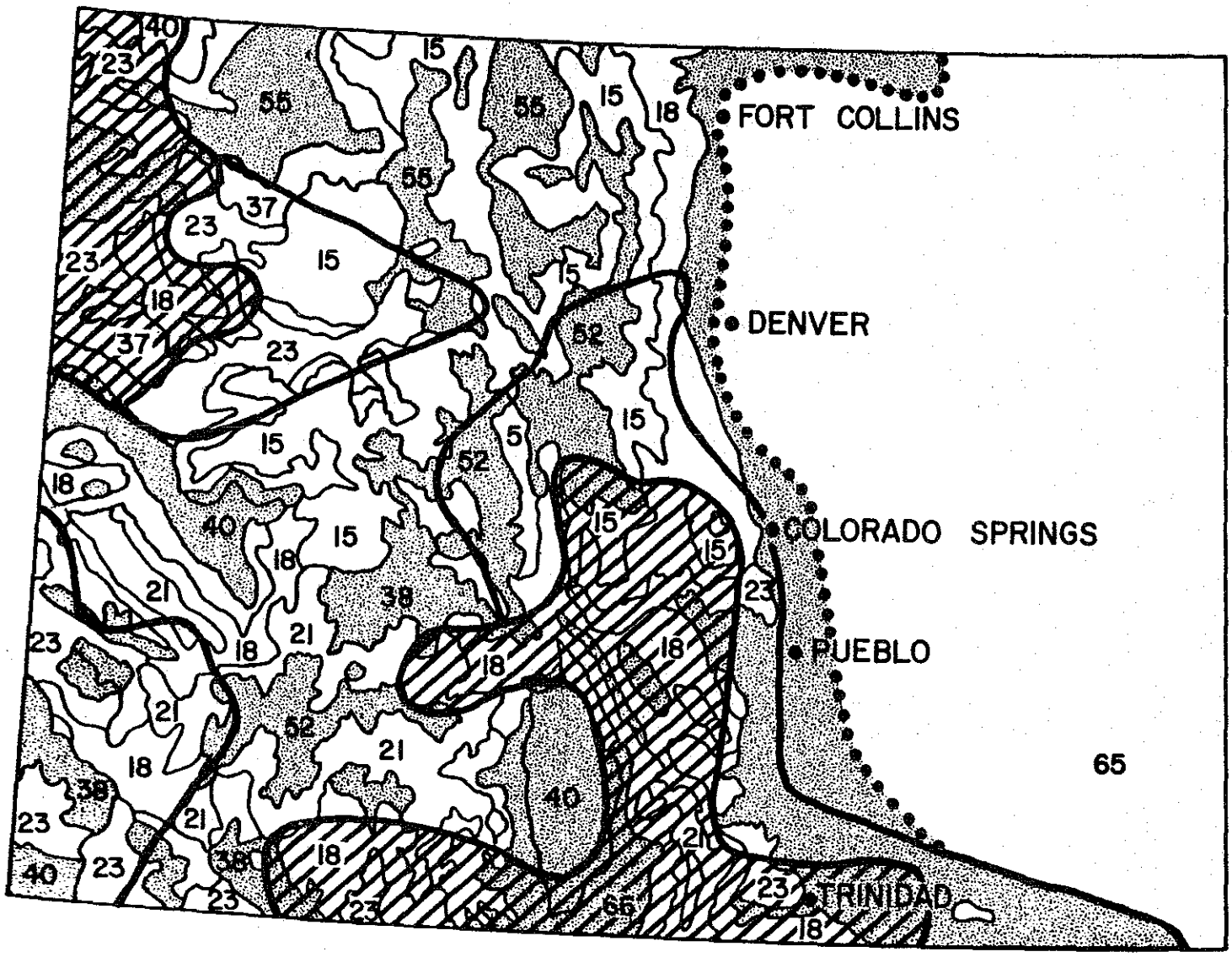
40 Saltbrush-greasewood

52 Alpine meadows

55 Sagebrush steppe

65 Grama-buffalo grass

66 Wheatgrass-needlegrass


FORT COLLINS
DENVER
COLORADO SPRINGS
PUEBLO
TRINIDAD
65

calculation of the mountain lion population can be made. It is assumed that trees are needed for stalking cover in order for mountain lion densities to be high or medium. All of the areas with non-tree climaxes but with reported mountain lions are assumed to be low density areas. This modification of the density map results in about 29500 km^2 (11400 mi^2) of high density area, 25600 km^2 (9900 mi^2) of medium density area, and 111000 km^2 (42700 mi^2) of low density area. My study areas were both located in high density portions of the map. Therefore, one lion per 39 km^2 (15 mi^2), a rounded average of the density estimates of the two seasons, will be assumed to be the high density figure. This represents a total of 760 mountain lions on the high density areas. No study has been undertaken on mountain lions inhabiting medium or low density areas in Colorado, so population estimates for these areas are tenuous at best: for medium densities, one lion per 78-150 km^2 (30-60 mi^2), or 170-330 mountain lions on medium density areas; for low densities, one lion per 260-650 km^2 (100-250 mi^2), or 170-430 mountain lions on low density areas. The total statewide mountain lion population estimate is 1100-1500 mountain lions. Possible errors in the estimate are: (1) the density map is unrealistic, (2) the vegetational climax map is unrealistic, or (3) the population estimates for the different densities are unrealistic. A way to check for errors in each case would be to carry out at least two more capture or track studies, one in a supposedly medium

population density area, and one in a supposedly low population density area.

The key to the distribution of hunting pressure rests both in the hands of the guide-and-outfitters and the Division of Wildlife. Seventy-two percent of all the lions harvested in Colorado since 1971 were taken by hunters accompanied by guides (unpublished data, Colorado Div. Wildl.). The Division allows each guide to conduct hunts only in a specified area. A guide-and-outfitter will apply for an area where he can consistently take lions. Much of his success depends upon how well he knows an area, as well as the number of lions there.

The mountain lion population density is probably controlled by several different factors. The main external factors are probably prey availability (a combination of prey abundance and stalking cover) and predation by man, although disease and accidents do take a toll. Internal factors might be behavioral or physiological responses to stress and crowding. Therefore, a finite limit to increase in a lion population exists. Humans can influence two of the factors that limit mountain lion density and therefore population size: predation by man and prey availability. If the present lion population is limited by hunting mortality, and if the deliberate killing of mountain lions were discontinued, the lion population would increase until another factor limited it. It would then stabilize at that level. If the present population is not limited by hunting mortality,

cessation of hunting would not have any effect upon it. If the present lion population is limited by prey abundance, and if deer hunting were discontinued, two outcomes are possible: (1) deer numbers could increase, if their population is limited at present by hunting, thus allowing the lion population to increase until either the deer population stabilizes or some other factor limits the lion population, or (2) if the deer population is not limited by hunting, there would be no increase in either the deer or lion population. If the present lion population is not limited by deer abundance, cessation of deer hunting would have no effect on the population. Probably the only way any of the potentially limiting factors could result in extirpation of the mountain lion would be for at least one of the factors to continually change to the population's detriment. If more and more stalking cover and deer habitat are lost to commercial and residential development, or if hunting pressure continues to increase despite a decrease in the rate of return, serious damage to the lion population will result. Of these two threats to the lion population, the loss of habitat appears to be the more immediate.

Hornocker (1970) found that the mountain lion density on his study area remained constant, even though the density of the prey species increased. This would indicate that above a certain prey density, some factor other than prey density regulates mountain lion density. Below that critical prey density, food supply probably regulates mountain

lion density, if other factors aren't limiting. Hornocker concluded that lion predation was not controlling the ultimate numbers of the prey species in his area. Therefore, one would expect that an increase in the deer herds throughout the state would not necessarily be followed by an increase in the mountain lion population. On the other hand, the prey density might be below the critical density in certain areas. By increasing the deer density in those areas, the mountain lion density could also be increased.

If, however, deer density decreased below the critical density, one of two things might occur. Mountain lion density might decrease, or it might remain the same, with the lions killing more cattle. Shaw (1976) suggested that the number of cattle taken by lions might be inversely proportional to the size of the deer herd. With fewer deer to eat, perhaps more cattle would be taken.

The mere presence of man does not seem to frighten away mountain lions, as it does some other wildlife. A lion was trapped at a deer kill about 100 m (300 ft) from a rancher's house near Virginia Dale during the summer of 1975. Another lion was reported to have scared a rancher's dog away and eaten its food on a ranch west of Loveland during the fall of 1975. During late winter, 1976, a mountain lion came onto the grounds at Cheyenne Mountain Zoo in Colorado Springs and killed a snowy owl in its cage. Another lion became trapped in a garage in Canon City during the summer

of 1975. A lion was killed in a barn, near Kim, during the summer of 1976.

CONCLUSIONS

The hypothesis that there was at least one mountain lion per 60 km^2 (23 mi^2) on the study area was supported by the data obtained during my study. The lion density is fairly high, and the lion population on the study area does not seem to be threatened by excessive hunting.

The statewide mountain lion population is probably larger than formerly estimated. It does not appear to be in danger of being over-harvested.

The mountain lion is an adaptable animal, as evidenced by its widespread distribution. It avoids direct contact with man but it does not flee from civilization. Both human and lion populations can coexist, with a minimum of friction between the two, if appropriate management practices are observed and predevelopment impact analysis carried out.

LITERATURE CITED

Cahalane, V. H. 1964. Cougar, grizzly and wolf in North America. New York Zool. Soc., 12 pp.

Colorado Division of Wildlife. 1974. Strategic plan for mountain lion. Pages 27-28 in The strategy of today, for wildlife tomorrow, Vol. I. 103 pp.

Dixon, K. R. and R. J. Boyd. 1967. Evaluation of the effects of mountain lion predation. Colo. Div. of Wildl., P-R Rep., Proj. W-38-R-21. 24 pp.

Donaldson, B. R. 1975. Mountain lion research. New Mexico Dept. of Game and Fish, Final Rep., Proj. W-93-R-17. 18 pp.

Eads, F. E. 1976. Tilazol™ (CI-744): a new agent for chemical restraint and anesthesia in nonhuman primates. Vet. Med. Sm. Anim. Clinician 71(5):648-652.

Eaton, R. L. and K. A. Verlander. 1976. Reproduction in the puma: biology, behavior and ontogeny. in R. L. Eaton, ed. The world's cats, Vol. III, No. 3, Contributions to breeding and husbandry. World Wildlife Safari, Winston, Oregon. (In press)

Hornocker, M. G. 1969. Winter territoriality in mountain lions. J. Wildl. Manage. 33:457-464.

_____. 1970. An analysis of mountain lion predation upon mule deer and elk in the Idaho Primitive Area. Wildl. Monog. No. 21:1-39.

Hunter, J. S. 1921. The control of the mountain lion in California. Calif. Fish and Game 7:99-101.

Kuechler, A. W. 1975. Potential natural vegetation map, conterminous United States. Am. Geog. Soc., New York, N. Y.

National Oceanic and Atmospheric Administration, Environmental Data Service, National Climatic Center. 1974-76. Climatological Data: Colorado. 79(12), 80(1-3,12), 81(1-5).

Nowak, R. M. 1976. The cougar in the United States and Canada. Admin. Rep., U. S. Fish and Wildl. Serv., Office of Endangered Species, Washington, D. C. 190 pp.

Sandfort, W. W. and R. J. Tully. 1971. The status and management of the mountain lion and bobcat in Colorado. Proc. Symp. Native Cats of N. A. 1:73-85.

Seidensticker, J. C., IV, M. G. Hornocker, W. V. Wiles, and J. P. Messick. 1973. Mountain lion social organization in the Idaho Primitive Area. Wildl. Monogr. No. 35:1-60.

Shaw, H. G. 1976. Impact of mountain lion (Felis concolor azteca Merriami) on mule deer and cattle in northwestern Arizona. Arizona Game and Fish Dept., 39 pp.

Weddle, F. 1966. The cougar in our national parks and monuments. Nat. Parks Mag. 40:4-7.

Appendix A. Letter given to landowners to explain the study.

Colorado Cooperative Wildlife Research Unit

Cooperative Units Building
Colorado State University
FORT COLLINS, COLORADO 80521
Telephone: 491-5396

COOPERATORS
Bureau of Sport Fisheries and Wildlife
Colorado Division of Wildlife
Colorado State University
Wildlife Management Institute

Dear Landowner:

This letter is to identify the members of a field team conducting studies on mountain lions in Colorado. Ms. Mary Jean Currier is a graduate student at Colorado State University and will be accompanied by a licensed Colorado guide. On occasion one or two other persons may be working with them.

The purpose of their work is to tree mountain lions, immobilize them with a drug, attach an identifying collar, collect blood and hair samples, then release them unharmed. The resulting information will be used to help analyze the status of selected populations of mountain lions in Colorado. This research is principally funded by and is being carried out on behalf of the Colorado Division of Wildlife.

We respectfully request your cooperation and assistance.

Sincerely,

Kenneth R. Russell

Kenneth R. Russell
Leader

_____
Date

Appendix B. Data sheet.

[ ] Collar number
[ ] Ear tag number

Colorado Cooperative Wildlife Research Unit
Mountain Lion Population Study
[ ] Initial Capture Data
[ ] Observation of Previously Marked Lion

_____ Date (Day, Mo, Yr)
_____ Location (8 digit)
_____ Elevation (m)
_____ Time (24 hr)
_____ Sex
_____ Estimated age (yrs)
Yes No Female pregnant
Yes No Female lactating
_____ Estimated weight (lbs)
_____ Actual weight (lbs)
_____ Total body length (cm)
_____ Girth (cm)
_____ Skull arch (cm)
_____ RF center pad ln (mm)
_____ RF center pad wd (mm)
_____ RR tarsal ln (cm)
_____ Tail ln (cm)
Yes No 2 vibrissae collected
Yes No Hind leghair collected
Encounter site conditions
[ ] [ ] [ ] [ ] Habitat [ ] Terrain
[ ] Snow [ ] Tracking
Relative abundance
[ ] Elk-Deer [ ] Livestock
[ ] Other mammals
Yes No Photos taken

_____ Drug
_____ Volume (mg)
_____ Rate (mg/lb)
[ ] Injection site
_____ Injection time
_____ Ataxia time
_____ Immobilization time
_____ Down time
_____ Acepromazine time
_____ Acepromazine volume (ml)
_____ Atropine time
_____ Atropine volume
_____ Antibiotics volume
_____ Pulse rate _____
_____ Pulse rate _____
_____ Pulse rate _____
_____ Resp. rate _____
_____ Resp. rate _____
_____ Resp. rate _____
_____ Rectal temp. _____
_____ Rectal temp. _____
_____ Rectal temp. _____
_____ Ambient temp. _____

Habitat Description

Number	Composition
1	Grassland
2	Brush
3	Oak
4	Pinyon-juniper
5	Aspen
6	Ponderosa
7	Londgepole
8	Spruce
9	Fir
0	_____

Number	Height
1	<1m
2	1-3 m
3	4-10 m
4	>10 m

Number	Density
1	Open
2	Moderate
3	Dense
4	Closed canopy

Number	Terrain
1	Ridge top
2	Ridge side-top 1/3
3	Ridge side-middle 1/3
4	Ridge side-bottom 1/3
5	Canyon floor
6	Plateau
7	Mesa
8	Rangeland
9	Draw
0	_____

Number	Snow Depth
1	None
2	Trace
3	<2 cm
4	2-10 cm
5	11-30 cm
6	31-50 cm
7	51-70 cm
8	71-100 cm
9	>100 cm

Number	Tracking Conditions
1	Good
2	Marginal
3	Poor

Number	Relative Abundance
1	Abundant
2	Common
3	Scarce

Number	Injection Site
1	Hip or hind leg
2	Abdominal region
3	Thoracic region
4	Back
5	Neck
6	Shoulder or fore leg
7	Head
8	Tail
9	Udder
0	Unknown

Number	Amount of Carcass Eaten
1	<10%
2	10-25%
3 3	26-50%
4	51-75%
5	76-90%
6	>90%

Number	Method of Kill
1	Bite
2	Blow
3	Claw
4	Unknown

Number	Site attacked
1	Neck
2	Back
3	Throat
4	Abdomen
5	Thigh
6	Head
7	Face
8	Thoracic
9	Unknown

Appendix C. Accounts of the captures of mountain lions during the first and second study seasons.

First Study Season (Winter, 1974-75)

Collar and tattoo No. 1; 12 February 1975; spotty snow.

The W.C.O. for Canon City, Dwayne Finch, called us at 1830. He said a lion was caught in a trap west of town and asked us to come immediately to immobilize it, then process and release it. We skipped supper, and John Fabian (our next-door neighbor), Joe Pecharich (houndsman), and I loaded up the equipment and set off down Shelf Road. We picked up Dwayne at his home and drove out to a little box canyon under the second bridge on Tunnel Drive. The lion was caught in a trap on the floor of the canyon, and we could see his eyes gleam from the road above. Dwayne said he was big, so I loaded the dart for a 64 kg (140 lb) animal, and Joe, John, and I scrambled down the cliff to the bottom. The people above (a newspaperman, the family who discovered the lion, and Dwayne) shined a spotlight on the lion, but we still couldn't see him. We got about 6 m (20 ft) from him, and I fired and missed. After loading another dart, we tried again. This time the lion was moving around, and we were afraid he was going to break the wire holding the trap. The dart hit him just behind the right shoulder. He was having trouble moving in about 3 minutes and was down in 5 minutes. Joe tattooed his ears, and I tried to find the

saphaneous vein beneath all of his hair. I rubbed alcohol on and looked and looked but couldn't find it. Finally, I started to cut off hair in the vicinity and found it. I drew enough blood for plasma but couldn't get enough for serum. No. 1 was beginning to move, so I gave him enough drug for an additional 9 kg (20 lb). We measured him, then weighed him: only 36 kg (80 lb). I had given him almost double the dose. I took some more blood from the other leg, then we stood back to watch him, hoping that he would soon recover. In about an hour and a half after the first dose he started stumbling around. After two and a half hours he looked as if he could negotiate pretty well, so we left him at about midnight. The next afternoon at about 1330 Joe and I went back to the box canyon. We saw No. 1 where we had left him. At first I thought he was dead, but when he saw us he staggered behind a rock. Then I was afraid he was disabled. Joe went down into the canyon and approached him, talking. When No. 1 realized he wasn't as well hidden as he thought, he leaped gracefully up the canyon wall opposite me, slipping once, recovering, and was gone.

Collar and tattoo No. 2; 16 February 1975; good snow cover.

Joe and I had our horses saddled at Bus Willis' place and were waiting for Don Justman, a guide in the area who was going to show us some new country, when Don called. He said he had cut a nice fresh track just north of George Rupp's place. We drove there and looked at the track. It

was a good track, and the snow was in excellent condition, so we took off on foot and chased the cat for about two and a half hours. Don and I watched the further progress of the chase from a hillside across the valley, while trying to get to the ridge where all the action was. The lion just would not tree, even though there were lots of trees around. We occasionally heard a dog yip when it was struck. Don was sure a dog was dead. We hurried up the hill and Joe came over another one. There was blood all over the snow. The lion ran by Joe two times and approached Don once. She never seemed to be in much of a hurry. I darted her for 45 kg (100 lb), which only slowed her down a bit. I wanted to dose her for 36 kg (80 lb) more, but the second dart hit her broadside. The third hit her in the neck and made her lose control. We had to pull the dogs off her; Bugle had her by the throat. Both Bugle and Prince were pretty badly cut up and had to be taken to the vet's for stitches. No. 2 turned out to be a huge old female. She was pretty well recovered in about three hours, so we left her.

Appendix C. (Cont'd)

Second Study Season (Winter, 1975-76)

Collar No. 40, tattoo No. 04; 25 Nov 75; fair snow cover.[1]

A lion kitten was observed near an elk kill on 24 Nov 75 by Dan Riggs, the W.C.O. from Westcliffe. Dan, his son Dean, Gary Walker (houndsman), Boyd Canterbury (Gary's friend), Steve Sheriff, and Ken Russell returned to the kill site at about 1415, 25 Nov 75. The female was treed by the dogs within 600 m (2000 ft) of the kill site. Dr. Russell shot her in the hip from a distance of 14-18 m (45-60 ft) with a 3 cc dart and low power (green) powder charge. All but the fibre on the dart's tail penetrated the hip muscle. The drugged lion was removed from the tree by looping a rope around a hind foot, then was lowered rapidly to the ground. She appeared to be fully anesthetized for only about 20 minutes. When data collection began at 1515, she was moving her head freely. She became increasingly active throughout handling. After the female was fully processed, the kitten was brought to the same site for handling. The presence of the kitten and the handlers agitated the female to a point where it was decided to discontinue handling the kitten after its tattooing had been completed. The

---

[1]The accounts of the capture and processing of this female and kitten are second-hand. I was out-of-state at the time these lions were captured and processed. - M. J. P. C.

female slid down the snow bank and was seen crawling away at about 1615.

No collar, tattoo No. 14; 25 Nov 75; fair snow cover.

The kitten was attacked by the dogs. A brief and unsuccessful attempt was made to take the blood sample. A 1-3 cm (0.5-1 in) skin tear was made in the process, but the vein wasn't found. The kitten was found dead by Dan Riggs at the site the next day.

Collar and tattoo No. 5; 3 Jan 76; spotty snow.

We found a fairly large track going north, about a mile east of the Willis' house. A few dogs belonging to Don Justman and a few of Chuck Anderson's dogs were turned loose on the track. They probably followed the track to a kill, then switched to a smaller set of tracks that turned out to be those of No. 5. Ken Russell and I drove the truck to a point about 1 km (0.6 mi) from where the lion was treed. I was using a new gun, which was not yet sighted in, and I shot the branch under the lion on my first try. My second shot went into her chest, and she immediately left the tree. Chuck took Pup, his best lion dog, and followed her for about 500 m (1600 ft), until the lion collapsed. She had beautiful eyes: a ring of chocolate around the pupil, then a band of turquoise flecked with gold, surrounded by an outer band of gold. At one point Pup, who was tied nearby, started chewing on the lion's tail, but no damage was done.

Jake, another of Chuck's dogs, got loose from where he was tied at the original tree, but he ignored the immobile lion. She was fairly slow to recover, so Dr. Russell and I stayed with her until about two hours after she was darted.

Collar and tattoo No. 6; 5 Jan 76; spotty snow.

We walked up the canyon next to Gooseberry (on Nate Patton's land), where we found fairly large tracks all over the place, often with foot-drags. All three of the dogs were turned loose. Gray Currier, my husband, tried to stay with Pup while Chuck and I tried to find where the other dogs had gone. Because of the spotty conditions, Gray lost Pup's track. He went back to the truck and drove along the mouths of several of the gulches, listening for the dogs. We found Pup's track again and followed it across a corner of Dave Nash's land. Banjo found us, so Chuck sent him on the track, too. Someplace along the line Belle joined in. We (Chuck and I - Gray was following our tracks) caught up with the dogs on the south slope of Cedar Gulch, where they were having some trouble. We took them up a short distance to the north slope of Long Gulch, and they took off. We followed them down into Long Gulch, then back up the same slope we had just come down. About halfway up we found an iced patch of snow on a rock overlooking the valley - probably where No. 6 had rested. When we got to the ridge top, we heard the dogs barking "treed" a little below us, but still on the north slope. We waited a bit for Gray, then I

shot the lion in the shoulder. He bailed out about two minutes later, so we took the three dogs, on leashes, down the trail. About 300 m (1000 ft) later it was obvious he wasn't slowing down, so we turned the dogs loose again for another chase of about two miles up Long Gulch, then up a side canyon. It was about 1600 when I darted him again, in the flank. He climbed out on a high limb and wouldn't come down, in spite of our rock throwing. Chuck went up with a rope, tied it around his hind leg, and pushed him out. The rope broke without causing even a slight hesitation in his fall of about 12 m (40 ft). No bones seemed to be broken, so we processed him in the usual manner. The original dart was still in him, and we discovered the detonator charge had not fired. He had received little of the original dose. He recovered quite rapidly, so we left him right after processing. We walked 10 km (6 mi) out to Jim Like's ranch in the dark. From Jim Like's it was a long way to our truck, so we called Dwayne Finch, who picked us up and took us back to camp. Two days later Bob Peters (a local guide-and-outfitter who helped us throughout the second season) and Chuck Griffin (a friend of Chuck Anderson's) came hunting with us. Chuck Griffin's dogs treed No. 6 one canyon north of Long Gulch, so the lion was apparently all right.

Collar and tattoo No. 7; 8-9 Jan 76; spotty snow.

Bob Peters and Chuck Griffin found a rather large track crossing south on the Dilley side of the Dilley-Thorson

road. They cut the road following the powerlines but didn't find the tracks crossing north again, so they turned the dogs loose on the original track. Unfortunately, they had just missed No. 7's track in a proliferation of deer tracks. We cut ahead of them in the truck and found the track continuing north. We drove up Thorson's road as far as we could and followed the track on foot. We traveled north most of the day, until we were almost across from Nipple Mountain. At that point, the track turned west. The dogs probably treed No. 7 in some very rough country on the Shoemaker land. Since it was already dark, Chuck Anderson and Bob walked down to Shoemaker's, while Gray and I stayed with Chuck Griffin, who was not feeling well. The dogs remained with No. 7. Next morning, we drove to the place where we had last heard the dogs. We could not hear them now, so we started climbing the cliffs west of the road. We found the dogs and lion about two hours later. No. 7 was sleeping peacefully in the tree. He awoke abruptly when I darted him, and he promptly bailed out. We followed him with Pup and found him a short distance down the hill. Bob took his dogs and went to get the truck, while we processed the lion. When Bob got back to the truck, he found that a lion had crossed behind it since we had left it, so he turned his dogs loose on the track and went to pick us up. (See the account of No. 8's capture).

Recapture of No. 7; 6 Feb 76; light snow cover.

Since it had snowed lightly the night before, we took two trucks. Gray and I found a track on Shoemaker's with a dusting of snow in it, so we turned Banjo and Jake loose on it at 0715 and set out after them. The snow melted as soon as the sun touched it, leaving no trace of where either the lion or the dogs had crossed. Since both of the dogs are quite silent when they are trailing, we had a difficult time following them. I think they had No. 7 treed several times, because when we finally heard them and tried to get to them, they were in different places. I stayed high on the ridge, and Gray dropped down, so we lost contact with each other for awhile. When I found the dogs and No. 7 at about 1400, he was treed next to a high outcrop of rocks, with Jake only about 1 m (3 ft) in front of him. When Jake looked at me, No. 7 took the opportunity to bail out. Jake must have jumped on him and gotten scratched, because I heard a ki-yi. I looked over the ledge and saw the lion trotting by about 15 m (50 ft) below, followed by Banjo, then, about 30 seconds later, by Jake. This time, he bayed up on a ledge, and once more rapidly exited when the dogs looked at me. They finally treed him in a fairly large tree next to an outcrop of rocks, so we were able to take several pictures of him and ascertain that he was indeed No. 7. Meanwhile, Chuck, with Wayne Shoemaker and Jay Lovelady, were trying to find us, but they were on the wrong road. We figured out where they were and walked to that road. We radioed where we

were, but we could get no answer. Later we found out that their radio was too weak to send. They picked us up at about 1730.

Collar and tattoo No. 8; 9 Jan 76; spotty snow.

After No. 7 was treed, Bob Peters went back to his truck, so that he could pick us up when we were done processing No. 7. When Bob got to the truck, he saw a lion track passing within 3 m (10 ft) of the truck. The track hadn't been there when the truck was parked. Bob turned loose his dogs, then came to pick us up. When we got back to the track, it was evident from the dogs' tracks that they had probably treed No. 8 but had not seen her go up the tree, so, failing to find any more tracks, they had taken the backtrack. Bob and Chuck took Chuck's dogs, with the exception of Jake, and set out on the track. Gray and I stopped to eat our lunch. About 15 minutes later, Gray said: "Here comes one of the dogs back." I peered up the hill and saw, to my astonishment, a lion sneaking back the way it had come. We jumped out of the truck and turned Jake loose on the fast-disappearing lion. She was treed a few minutes later, and we were able to drive the truck to within 10 m (35 ft) of the tree and process her.

Collar and tattoo No. 9; 29-30 Jan 76; spotty snow.

We followed two medium-sized tracks to the top of the ridge south of Willow Creek, through an area with a herd of

elk and many deer. Towards the end of the afternoon, the dogs couldn't push the track any further. The next day we came back, drove to the end of the road looking for tracks, then returned about one hour later, finding two tracks that had crossed the lower part of the road since we had driven up it. We turned the dogs loose, and they quickly followed the tracks up the dry south slope. They treed No. 9 a couple of ridges over. I darted her in the flank, and she bailed out and took off. Pup had trouble trailing her while on the leash, so Chuck turned her loose. I was nearby when she again barked "treed", so I charged through the snow to grab her before she could chew up No. 9 too badly. We had thought from the tracks that we were following two young lions. (At one point, it looked as though one had playfully hopped up on a log and then jumped down the other side, and in another place, one set of tracks ran around in a circle). However, No. 9 looked fairly old and, when weighed, turned out to be heavier than she had appeared. We decided she was probably the mother of the lion accompanying her. After processing No. 9, Chuck made a circle looking for the young one and within 20 minutes had it treed. (See capture account of No. 10). We checked the place where we had processed No. 9 when we were returning to the truck after processing No. 10, and we saw from her tracks that she had rolled down the hill and then abruptly run off, without even stumbling.

Collar and tattoo No. 10; 30 Jan 76; spotty snow.

After No. 9 was processed, Chuck circled the area, and the dogs treed another lion. When I began to get ready to immobilize it, I asked Chuck for the charges, which I had given him when we were getting ready to dart No. 9. We discovered they had been left behind. Both Chuck and Gray went back to find them. I stayed and talked to the lion and the dogs, trying to keep the lion interested in staying in the tree. Chuck had built a small fire so I could keep warm. He returned about 45 minutes later with the charges, saying he had not seen Gray. I darted the lion, and it bailed out. We had no trouble finding it and soon discovered it was a young female. Gray returned shortly, and we processed No. 10 without any problems.

Collar and tattoo No. 12; 5 Feb 76; light snow, melted.

Chuck found No. 12's tracks in Long Gulch while Gray and I were in the other truck, looking for tracks elsewhere. We drove to Long Gulch and followed Chuck's tracks. No. 12 was treed in the next canyon south. She appeared restless and looked quite large. I dosed the dart for 64 kg (140 lb). I made the second miss of the season when I shot too quickly, anxious because she had started to move out of the tree. We found the unfired dart later and were able to use the drug for on-the-ground injections. The second dart hit her squarely in the flank. The tree seemed to explode with snow flying, as she bailed out. When we found her, she still

wasn't immobile enough to work on, so I gave her enough additional drug for a total of 73 kg (160 lb). Even so, after processing (one-and-one-half hours after she was first darted), she got her head stuck in a hole under a stump. Her claws and feet were flying, trying to get her head loose. After I carefully helped get her head free, she sat there and glared at me, not looking the least bit wobbly.

Collar and tattoo No. 11; 25 Feb 76; dry.

I suggested we cut Parkdale before trying Spruce Basin. Chuck stopped the truck to check a track. It was a lion track. The dogs started having trouble with the track at the top of the hill, where the sun was melting the frost. They slowly worked it over the side of the hill to a pile of rocks about one-third of the way down. Since they were having trouble, Chuck dropped down to the wash below to look for tracks. All of the dogs followed him except Pup, who kept hammering the difficult track. All of a sudden she started barking oddly, and I rushed over to find her baying at a lion on the rock pile about 3 m (10 ft) from her. The other dogs and Chuck hurried back up the hill. I darted the lion from some rocks above, and she took off, running practically underneath me. The lion turned out to be a very old-looking one. We were done with everything by 1100.

Tattoos No. 13 and No. 14 (no collars); 1 Mar 76; dry.

Bob Peters took us to Little Cottonwood, where he had seen tracks of a female and two small kittens and a female with four large kittens. This was in the same locality as that in which his hunter had killed a female, four days earlier. The kill from which she had been jumped was now completely cleaned up. Nearby, we treed two kittens. I darted the first, No. 13, because it was too precariously perched to try to rope it. He was not completely immobilized, so we tied his front feet together, in order to process him. We turned him loose, and he staggered off. The second kitten was quite high in a tree, and after being darted was not immobilized even as much as the first, although he weighed less. He tried to climb out of the tree and fell a short distance. He scratched me when I reached for him (my only lion injury). Bob and Chuck circled the area to hunt for the mother or any other kittens. Shortly thereafter they treed "another" kitten about 1 km (0.5 mi) away. I darted him, and it turned out to be No. 13. (Since we didn't collar the kittens - they might have choked on a collar as they grew in size - and since we wiped off all traces of the ink we used to take their paw impressions, we didn't realize that the kitten, high in the tree, had already been processed, until we had darted him the second time and found his ear tattooed). This time, No. 13 was completely immobilized, but he growled from the time Chuck tied a rope around him to lower him until I finally let him loose. Eighteen

minutes after I darted him, I released him, and he galumphed down the hill. Unfortunately, it was probably the kittens' mother that had been killed by the hunter.

Recapture of No. 13; 15 Mar 76; spotty snow.

We wanted to check Little Cottonwood again to see if the kittens' mother had returned. We found kitten tracks, but no sign of any larger tracks with them. Chuck turned the dogs loose on them. We found two more kills about as old as the first along the way. Somehow, the three of us became separated, me without a walkie-talkie. There was deep snow on the north slopes, but none on the south slopes, and I couldn't find any tracks. By following the logical direction, I finally heard the dogs and found them in Cottonwood with a scared little No. 13 in a tree. Although it was hard to say, we thought he looked a bit thinner. Gray left a sandwich at the base of the tree, and we departed.

Collar and tattoo No. 16; 5 Mar 76; new snow cover.

While Chuck and his friend from Canon City, Jim Mathers, were cutting for tracks on Jim Like's land, Chuck's truck slipped off the road and into the gulch alongside, where it would have flipped over, had a dead tree not stopped it. Chuck turned the dogs loose, and two of them took off down the road, in the wrong direction. Chuck and Jim took Pup and walked a little further up Long Gulch, where they found a big lion track headed south. Chuck

turned Pup loose, sent Jim to follow, and started walking out of the gulch, looking for us and the other dogs. We picked him up, drove to the track, turned Banjo and Jake loose, and followed them, while Chuck took the Division truck to look for the other dogs. We followed the tracks up the south ridge, then west on top of it, and heard the dogs barking "treed" in the next canyon. No. 16 was perched high - about 15 m (50 ft) up - in a tree and looked quite large. Preparatory to darting No. 15, we tied up the dogs, with Banjo and Jake together and Pup separate so we could use her to follow the lion, should he bail out. Jake and Banjo started fighting, and Banjo got a death grip on Jake's ear and wouldn't turn loose. I piled on top of them to try to get them unchained from one another. We unsnapped them, and Jim grabbed Banjo. Gray, Jim, Banjo, and I all rolled down the hill. Then I darted No. 16 and instead of bailing out, he climbed about 3 m (10 ft) higher up and fell asleep there. Gray climbed the tree. The first 8 m (25 ft) were bare of branches, and his hands became scraped and bleeding. His gloves fell out of his pocket, and his hands became numb from the cold. When he reached the lion, he said: "I'm shoving him out." So down came No. 16, his fall broken by many branches, and he landed in the snow. No bones appeared to be broken. We processed him. Chuck rejoined us about halfway through the processing.

Collar and tattoo No. 15; 6 Mar 76; snow, melting.

The snow was already starting to melt on the south slopes when we stopped by the Canterbury's to ask permission to hunt on their land. Their son Tim had seen a lion at about 1730 the evening before. Another son, Bill, went with us to show us where it had been. The track looked rather old, so Chuck wanted to cut a circle around the area to find a fresher track. We drove as far as we could, then Chuck and Bill continued on foot. They saw nothing, so the dogs were turned loose on the old-looking track. Within 20 minutes they were barking "treed". No. 15 was young, heavy, and full of deer, so after processing her, we cut a circle and found a fresh deer kill - a big buck with an injured hind foot (it looked as though it had been caught in a trap or wire). It had probably been killed only hours earlier.

Recapture of No. 15; 1 Apr 76; dry.

No. 15 was retreed on the ridge above Short Creek, after Chuck started a large track in Hamilton Creek (the dogs must have switched tracks someplace).

Collar and tattoo No. 17; 11 Mar 76; dry.

We had walked almost to the bottom of Henthorne, when Pup picked up some scent. The dogs led us a little distance away to a kill that was still covered up. They had quite a bit of trouble sorting the tracks out, but finally headed back up Henthorne, then up a side gulch. They kept working

up and up until we could see the whole valley below. Finally, they all seemed to lose the track. We heard one bawl way off, from Belle, and Banjo and Pup started to backtrack. Gray and I climbed to the top of the mountain, but could hear nothing more. Chuck went flying off to stop Pup and Banjo (Pup never did make it to the lion). We continued in the direction we thought Belle might be and came over the ridge and heard three of the dogs barking "treed". Chuck got there first and warned us to be very quiet, because the lion was quite low in the tree and looked like she might bail out. She didn't and had to be lowered about 2 m (7 ft) down the tree, but she wasn't out very far. I had to give her another injection on the ground. The processing was routine.

Collar and tattoo No. 18; 26 Mar 76; dry.

All of the dogs but Pup disappeared, probably following a track that wasn't a lion's. Chuck took Pup and went looking for them. They found a two-day-old track in the dust, so Chuck sent Pup off on it. The radios weren't working properly, so Gray and I weren't sure exactly where to go. We ended up going a bit out of our way, but eventually followed them from Kerr Gulch just below the National Forest boundary, around the hill, into Hamilton Gulch, up past the microwave tower into Short Gulch, and up to where Pup had located the lion. (Pup had had some trouble locating him, because she didn't see him in the tree). He turned out to

be a nice young male and still had a spot under each foreleg, so he couldn't have been long out of kittenhood. The processing was routine.

Collar and tattoo No. 19; 30 Mar 76; fair snow cover.

Chuck took Pup, Dixie, and Jim and had a lion treed by around 0800. The radios weren't working properly, and Gray and I didn't find out about it until about an hour-and-a-half later. We took off on the track with Chuck and his friend, Stan Embree, at about 1000 and reached the lion by 1040. The first blank was not fully charged, so the dart described a pronounced arc and fluttered down through the branches. (We later found the dart). The second one hit him in his hind leg. After a little coaxing from a slingshot, he obliged us by bailing out of the tree and heading back towards the trucks. He was a nice tom, possibly the brother of No. 18.

Collar and tattoo No. 20; 27 Apr 76; dry.

The night before was very windy, so we were only able to find a couple of tracks in the road. The dogs couldn't get much scent out of them, although we could see they were very fresh. Gray and I drove on to Willow Creek, while Ken Russell stayed with Chuck's truck on Oak Creek Grade. Chuck took two dogs to make a circle around the area where the tracks were found. Pretty soon they cut fresh, unblown tracks, and a little while later they treed a scrawny young

female. Chuck drove to Willow Creek and got us, then we drove back and had a short hike to the tree. I dosed her for 36 kg (80 lb), and she bailed out. Chuck and I followed her a distance with Pup, then turned Pup and the other dogs loose. They had trouble with the track, and I didn't go over the proper ridge, so they treed her again and she bailed out before I got there. The next tree she chose was lower down in the gulch I was in. I was able to find it and dosed her again for 36 kg (80 lb). Later we found only about 0.5 cc had been injected, so she had received a dose for only about 9 kg (20 lb). Again she bailed out, and Chuck, Pup and I followed, and again we had to turn Pup loose. Pup treed her by herself. No. 20 was just a little bit groggy, so I gave her a dose for 18 kg (40 lb). This time, when we turned Pup loose, No. 20 was going out on the ground, so we had to pull Pup off of her. No. 20 stopped up the hill a bit from the trucks, so I carried her down to a flat place to work on her. Her nose and lip were scraped, and the upper pad on her front foot was torn completely off. She was bleeding slightly from the vagina, indicating that she was probably in her first heat. After processing her, I gave her an injection of antibiotics, and we left her.

Collar and tattoo No. 21; 5 May 76; dry.

Although rain was in the forecast, it hadn't rained yet when we got up at 0400, so we met Bob Peters, as scheduled, in Texas Creek. We drove up Texas Creek to the area known

as Big Hole and parked the trucks in the meadow. Then Chuck and Bob took the dogs (nine of them, 3 belonging to Chuck and 6 belonging to Bob) and went on up the mountain, with Gray and me coming along behind. We make a big circle, then Gray and I waited while Chuck and Bob made a cut towards Antelope Creek. The dogs found a track, but it took Bob and Chuck a while to figure out if it was a lion or a bear. We watched the whole drama from a high saddle across the valley with binoculars (we could even hear them shouting to each other). After a while Utah (Bob's dog) was way ahead of the others, and Chuck radioed that the lion was jumped, so Gray and I worked our way towards the dogs. They treed her in pretty short order in a fairly brushy tree. I dosed her for 45 kg (100 lb). She bailed out of the tree and hot-footed it down the mountain, but she didn't make it very far before she collapsed. When I reached her she was breathing slowly, and her jaws were moving spasmodically. I was afraid she might go into convulsions, but she didn't. She was fairly old, and her teeth were broken and worn, but she was pregnant with at least two kittens and had just eaten a good meal. She had a scratch down her hind leg that was just about healed.

Appendix D. Various measurements of the mountain lions captured during the study.

Date of Capture	Tattoo Number	Collar Number	Sex	Estimated Age* (yrs)	Weight (kg)	Length** (cm)
11 Feb 75	1	1	M	2.5	36	194
16 Feb 75	2	2	F	10	64	214
25 Nov 75	04	40	F	3-5		210
3 Jan 76	5	5	F	5	43	223
5 Jan 76	6	6	M	6	68	224
9 Jan 76	7	7	M	9	70	211
9 Jan 76	8	8	F	2.5	34	204
30 Jan 76	9	9	F	6	43	203
30 Jan 76	10	10	F	2	36	206
25 Feb 76	11	11	F	9	39	197
5 Feb 76	12	12	F	3	39	205
1 Mar 76	13	(none)	M	4 mo.	11	122
1 Mar 76	14	(none)	M	4 mo.	10	111
6 Mar 76	15	15	F	3	45	206
5 Mar 76	16	16	M	8	67	221
11 Mar 76	17	17	F	9	45	210
26 Mar 76	18	18	M	2.5	54	219
30 Mar 76	19	19	M	2.5	57	221
27 Apr 76	20	20	F	2.5	34	204
5 May 76	21	21	F	8	36	201

* Estimate based only on tooth wear and general appearance.

** Nose to tip of the bony tail.

Appendix D. (Cont'd)

Date of Capture	Tattoo Number	Print (Pad) Measurements (Length x Width) (cm) (to nearest 0.25 cm)	Track (Pad) Measurements (Length x Width) (cm) (to nearest 0.5 cm)
11 Feb 75	1		
16 Feb 75	2		
25 Nov 75	04	3.50 x 4.00	
3 Jan 76	5	2.75 x 3.75	3.5 x
5 Jan 76	6		5.0 x
9 Jan 76	7	3.75 x 4.25	5.0 x
9 Jan 76	8	2.75 x 3.75	
30 Jan 76	9	2.75 x 3.75	3.5 x 4.5
30 Jan 76	10	2.75 x 3.75	3.5 x 4.5
25 Feb 76	11	3.25 x 4.25	4.0 x 5.0
5 Feb 76	12	3.00 x 4.00	
1 Mar 76	13	2.75 x 3.50	
1 Mar 76	14	2.50 x 3.00	
6 Mar 76	15	3.50 x 4.50	4.0 x 6.0
5 Mar 76	16	3.50 x 4.50	5.0 x 6.0
11 Mar 76	17	3.00 x 4.00	3.5 x 4.5
26 Mar 76	18	4.00 x 4.25	
30 Mar 76	19	3.50 x 4.50	
27 Apr 76	20	3.00 x 3.75	3.0 x 4.5
5 May 76	21	2.75 x 3.75	4.0 x 4.5