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Mule Deer population Study for the City
OSMP Studies 4347

Study



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MULE DEER POPULATION STUDY FOR THE CITY OF BOULDER,
COLORADO PARKS AND RECREATION, AND OPEN SPACE DEPT.

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Abstract: Mule Deer (*Odocoileus Hemionus*) were censused by 4 observers (University of Colorado interns) in 4 study quadrants in a 16 sq. mile area comprised of 60% natural habitat and 40% urban environment representative of deer habitat. The Lincoln-Peterson method was used to determine the estimated population over a period of 7 years, from January-May, 1982-84 and from 1986-90. For the intended purposes of this study to monitor the population trends and movements of the Mule Deer with an acceptable range of accuracy. The Lincoln-Peterson method was acceptable. The approximate size and composition of the population was unknown. Recapture was based on observation of marked animals in the field. Procedures for conducting a census of this type and methods are thus detailed in this report.

INTRODUCTION

The Mule Deer Study was initiated by the City of Boulder, Co. in 1982. The original study was conducted by Western Resources Development Corp. from 1982-1984. Through the efforts of Boulder Open Space and Mountain Parks and the Colorado Division of Wildlife it was determined the on-going study must continue to gather more data from the project. The focus of the problem rest on the evidence that more deer have moved into the city limits resulting in plant and property damage including deer-vehicle collisions on the city streets. The lack of adequate documentation was not an inhibiting factor to establish a management plan. As outlined by Western Resource Development Corp. for the city of Boulder in October 1984, the following objectives were proposed:

1. Estimate the number of deer in the Open Space and Mountain Parks of Boulder and determine movement patterns.
2. Estimate the proportion of deer moving into the city and determine whether there are deer with high fidelity to either park or city areas.
3. Assess the severity of the deer-vehicle accident problem and identify areas of greatest conflict.
4. Develop possible management alternatives for consideration by the City of Boulder and the Colorado Division Of Wildlife.

This research paper will summarize the last segment (January-May 1990) of the two-year phase out of the Lincoln Peterson technique and its associated capture/markings program.

Study Areas

The study area included both Open Space and Mountain Parks land west of the city of Boulder. The north south boundary would begin at South Boulder Creek, then north to Lee Hill Road and those urban area's west of Broadway(fig.1). The western geographical boundary includes Dakota Ridge, Flagstaff Mountain and the South Mesa area. As shown in fig.1 the total land area is 16 sq. miles, of which 60% was of natural habitat and 40% made up urban environments that would represent deer habitat. All of the native vegetation is controlled by elevation, slope aspects and the available moisture to the Boulder Valley. Figures 2-5 represent each transit sector in the study area.

METHODS

Trapping and Marking

The original objectives and techniques employed for the study has remained consistent throughout the study. To satisfy the goals of estimating deer populations, discerning movement patterns and evaluating fidelity to specific areas in the study area would require that various trap sites (fig.1) be established to trap the mule deer. The trapped animals would then be marked with identifiable ear tags of color and number. The deer were caught in a cage unit(Clover 1956) baited with crushed apples. Traps were randomly established throughout the study area (fig. 1) to obtain a sample of the population. Each deer was double-tagged to prevent the loss of the animal to the study by loss of an ear tag (Beason, Burd 1983). The double tag simplified the task of identification by the observer. Tag color was associated with each of the four transit areas within the study area.

Population Estimates

In this study the mark-recapture method was used to estimate population size. This method employs the techniques of capture, mark and release a sample of a known number of animals back into the surrounding population. Throughout a period of 4 months, four University of Co. students acting

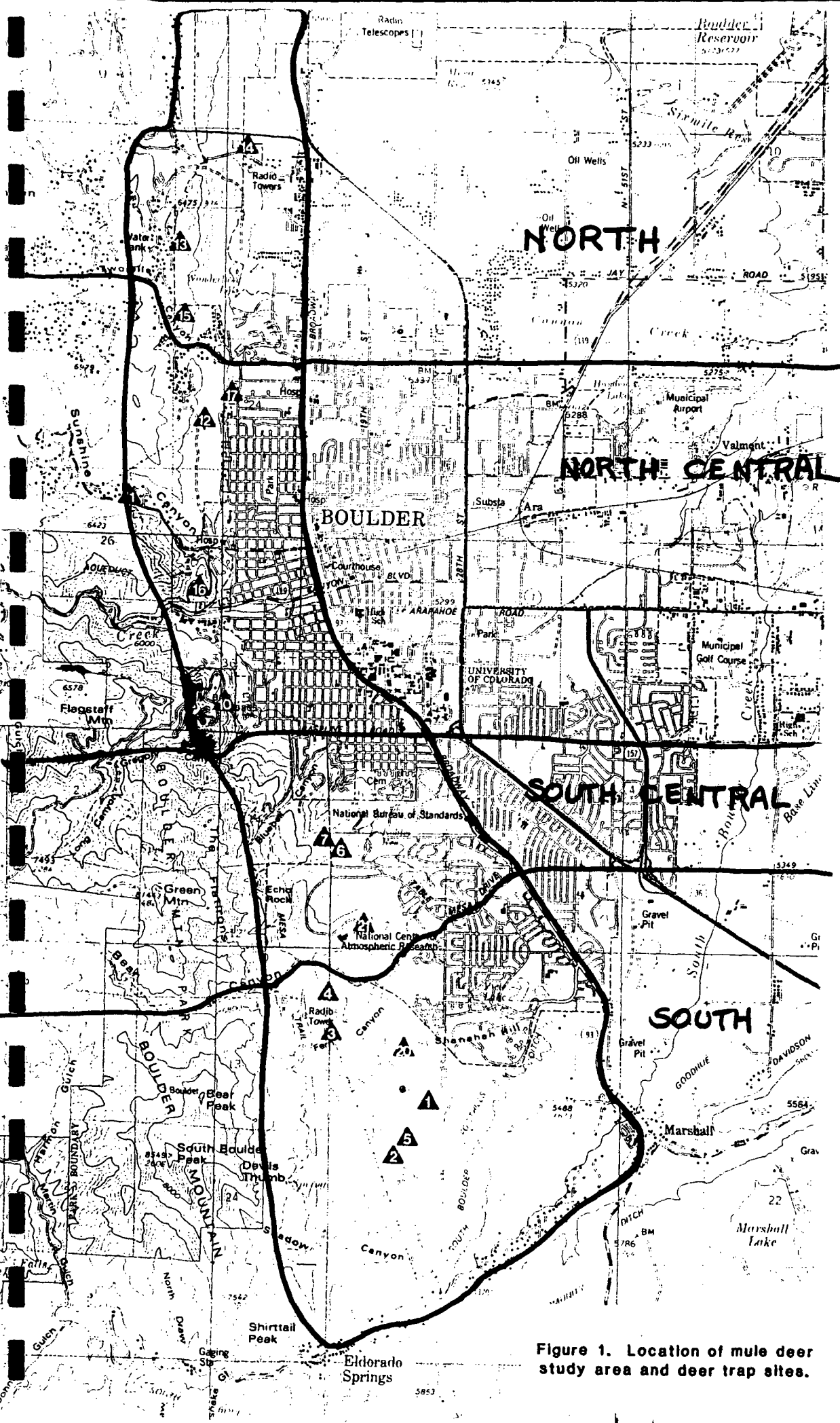
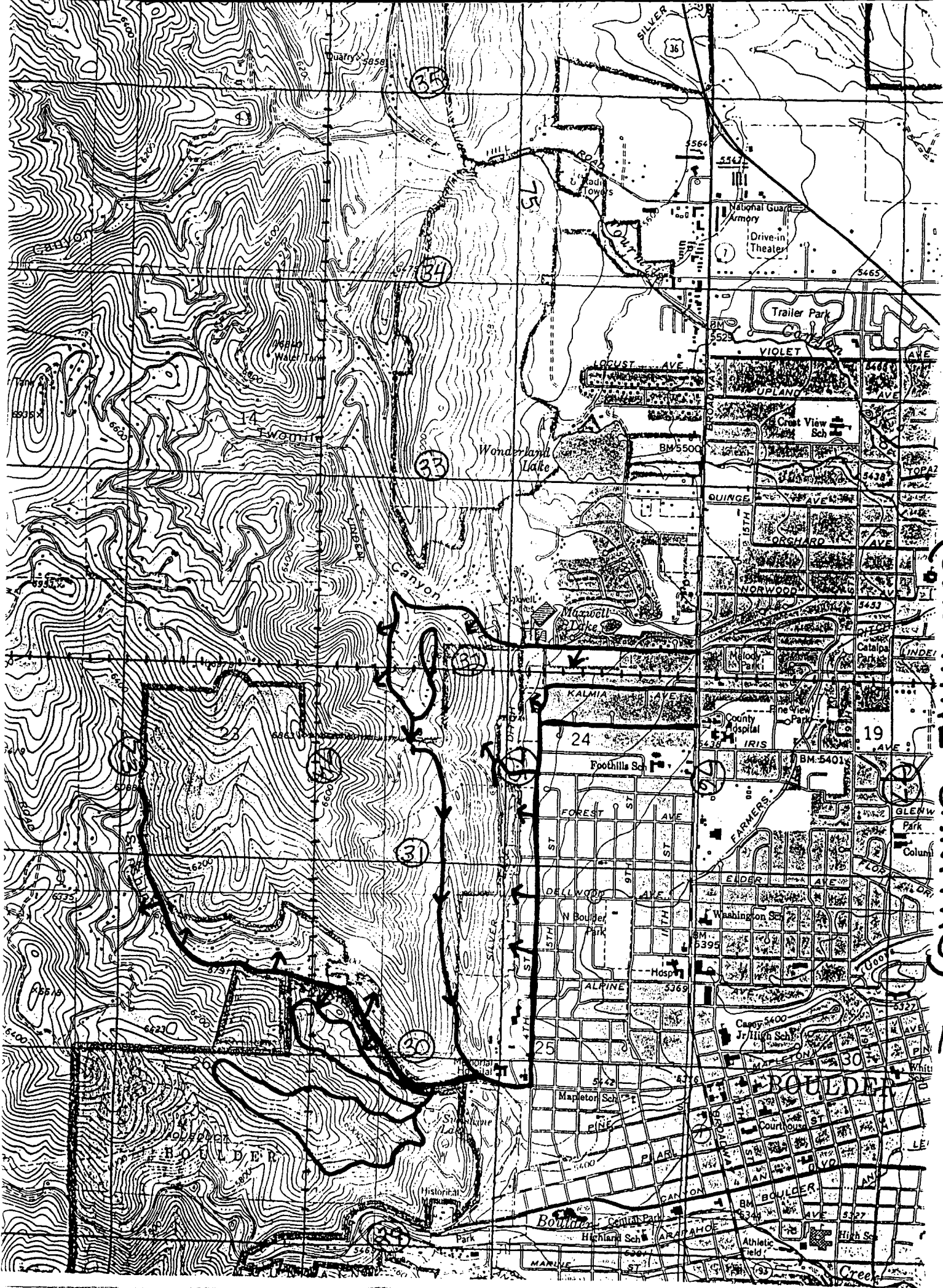
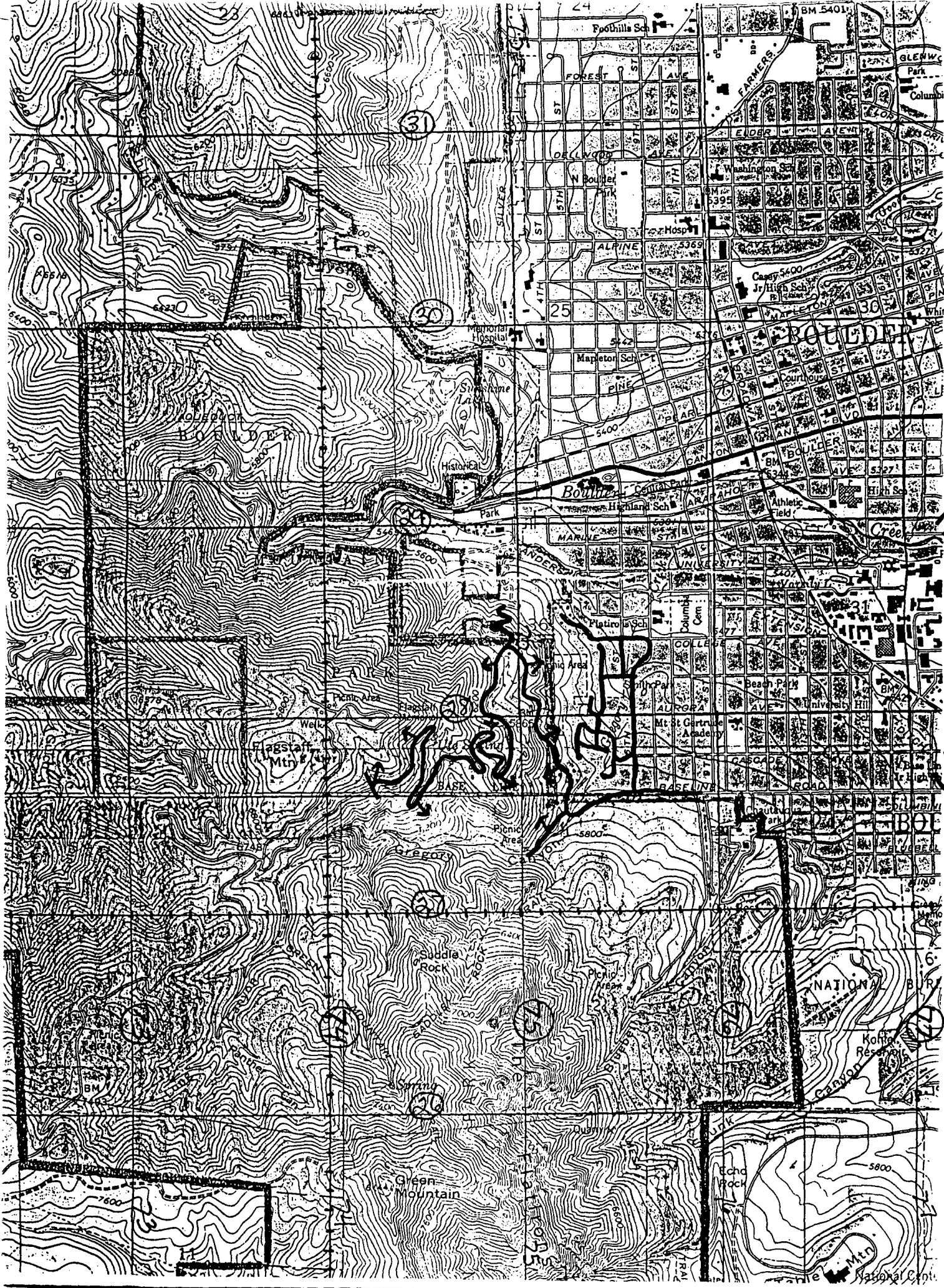


Figure 1. Location of mule deer study area and deer trap sites.



(SUNSHINE - SANITAS)

Fig. 2



(FLAGSTAFF)

Pg. 3

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FoodHills Sch

BM 5401

GLENWOOD Park

FOREST ST

OKLAHOMA ST

5TH ST

4TH ST

25

Mapleton Sch

PINE

5400

Historical

Boulder Canyon

Highland Sch

MARLE ST

ANDERSON

Victorio Sch

College

ALPINE

Mt. St. Gertrude Academy

BASE

5800

37

Saddle Rock

38

39

35

36

34

33

32

31

30

29

NATIONAL

Boulder Canyon

Koffel Reservoir

6.

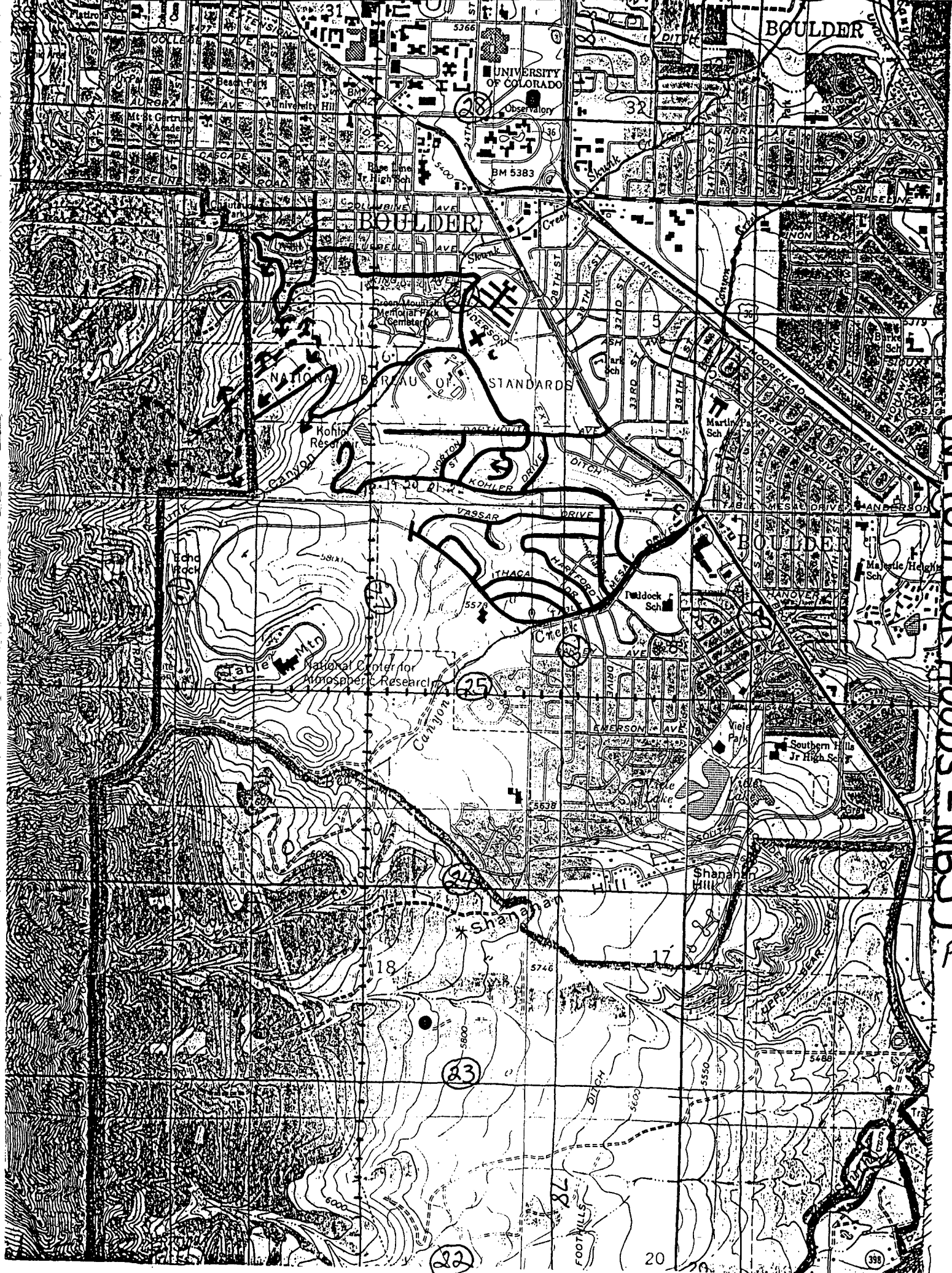
BUR

5800

Echo Rock

Mtn

National Center



BOULDER

UNIVERSITY OF COLORADO

BOULDER

STANDARDS

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

WILDOCK Sch

Southern Hills Jr High Sch

NEIGHBORHOODS - (NBS) Map 4

(22)

20

(398)



BOULDER

BOULDER

NATIONAL BUREAU OF STANDARDS

BOULDER

National Center for Atmospheric Research

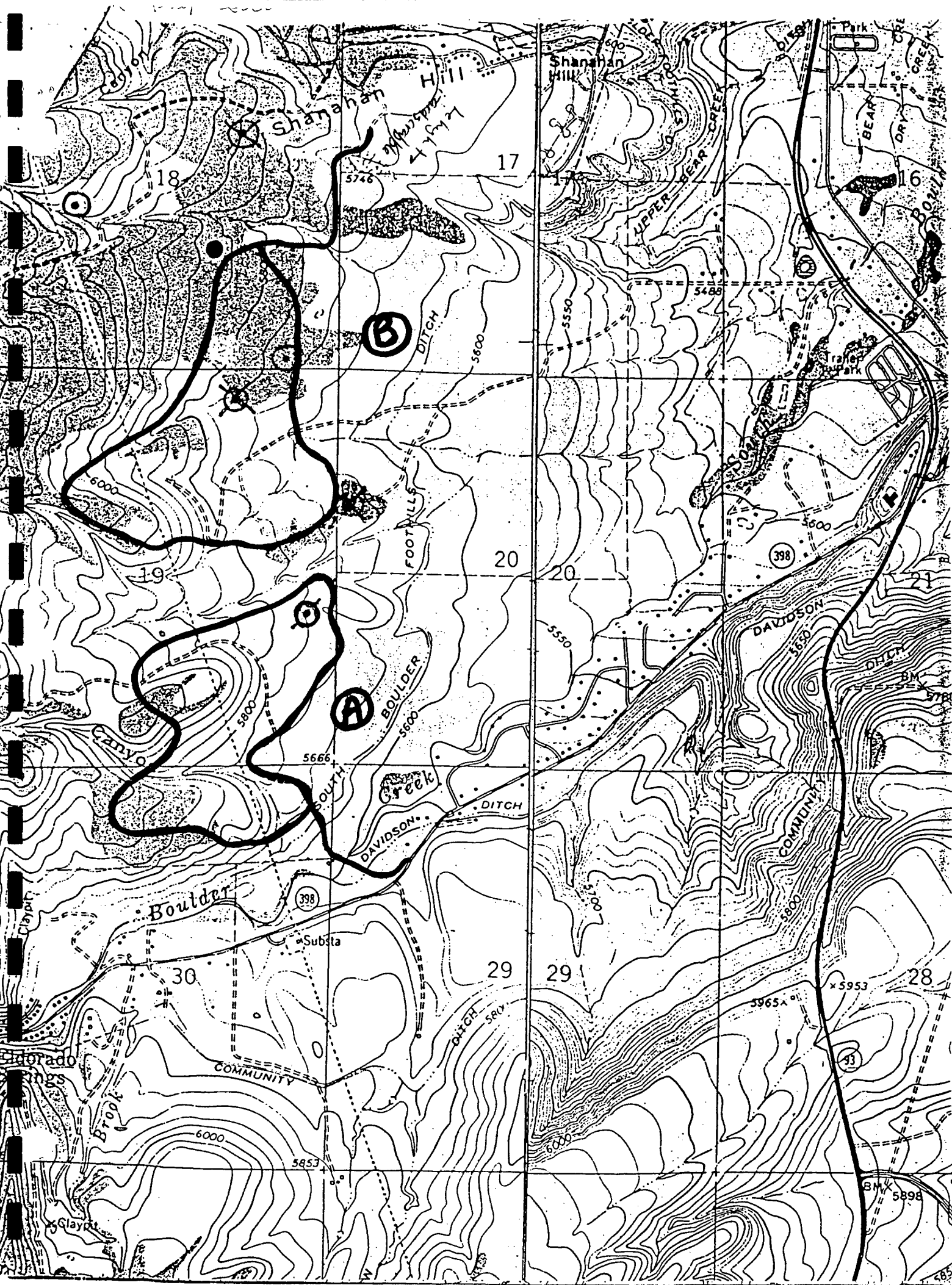
Southern Hills Jr High Sch

Shanahan Hill

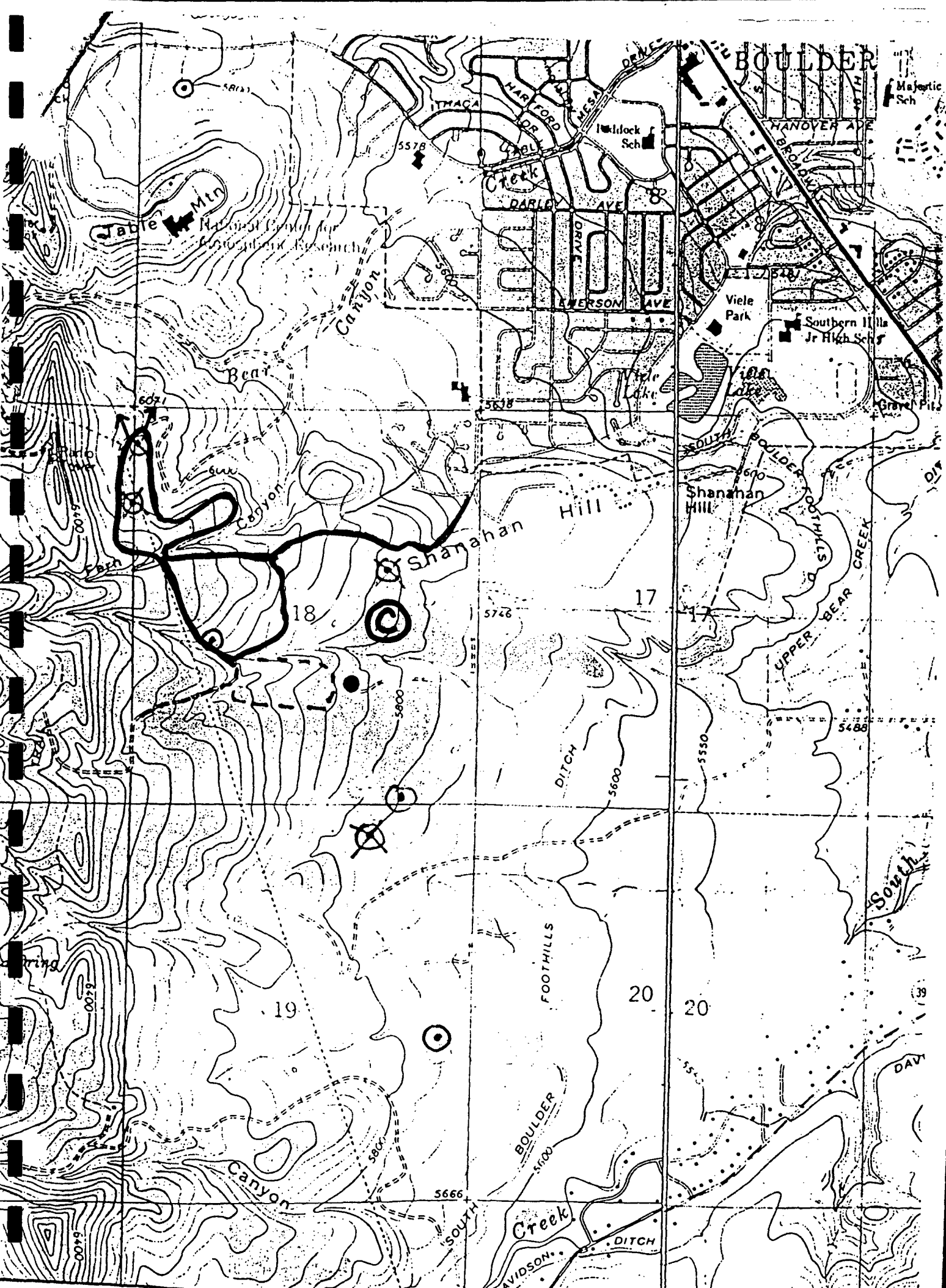
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NCARD

1/16/50



South mesa
16.6A



SOUTH MESA
F 6
66

in the capacity as interns assisted the staff of Open Space and City Parks in a census study. Each intern was assigned a transit sector within the study area and for the 4 month term walked the sector three times a week rotating through each sector every three weeks. The interns kept records of observed ear tagged deer in each of their assigned sectors. At the end of the study the staff of Open Space and City & Mountain Parks organized a 4 day census sampling session. The number of marked animals observed is compared to the number of unmarked animals. This ratio is assumed to be the same in the sample census as in the total population. From the information obtained a population estimate can be calculated. In fig. 6 the Lincoln-Peterson formula, calculations and results have been made for the study.

RESULTS

Accuracy Of Lincoln-Peterson Estimates

The estimated population of marked Mule Deer has dropped from the assumed figures of 83 in January 1989, to the new figure of 56 in April 1990. The resultant figures derived from the Lincoln-Peterson formula show an estimated population mean to be 1238 individuals. The standard error (SE) figure of 17.3 and the 95% Confidence Interval (CI) would establish the population to be 1204-1272. This study of seven years has satisfied the goals of the project designers and the results help determine the population trends and develop the management plans and strategies for the program. The required accuracy of the population estimate in regards to the intended use was acceptable to all concerned.

DISCUSSION

Mark-Observe Methods For Censusing Big Game

The Lincoln-Peterson method was an accepted technique used to study the Mule Deer and the results helped provide the needed information to organize efforts to manage the current and on-going problem. Our study has shown the difficulty of deriving accurate estimates of Mule Deer by the mark-observe

LINCOLN - PETERSON FORMULA

I. Population Estimation

$$N = \frac{(n_1 + 1)(n_2 + 1)}{(m_2 + 1)} - 1$$

WHERE:

N = Estimated Population

n₁ = Total number of marked animals assumed to be alive in the count area on count day.

n₂ = Total number of deer (both marked and unmarked) seen on count day.

m₂ = Total number of marked deer seen on count day.

II. Standard Error Estimate

$$SE (N) = \frac{1}{K(K-1)} (N_i - 1)^2$$

WHERE:

N = The mean population estimate for all count days
(In 1990 this was 1238)

N_i = The population estimate on a given count day
(In 1990 , Count Day 1 was 1476)

K = The sum of the samples from 1 thru K.

K-1 = The total number of count days in a given year
(usually 4, sometimes 3)

1990 DEER COUNT

I. Assuming there are 56 marked deer in the population.

Day 1 $\frac{(56+1)(595+1)}{(22+1)} - 1 = 1476$ Population Estimate

Day 2 $\frac{(56+1)(503+1)}{(26+1)} - 1 = 1063$

Day 3 $\frac{(56+1)(461+1)}{(18+1)} - 1 = 1385$

Day 4 $\frac{(56+1)(505+1)}{(27+1)} - 1 = 1029$

II. Standard Error

Day 1 $(1476 - 1238)^2 = 56644$

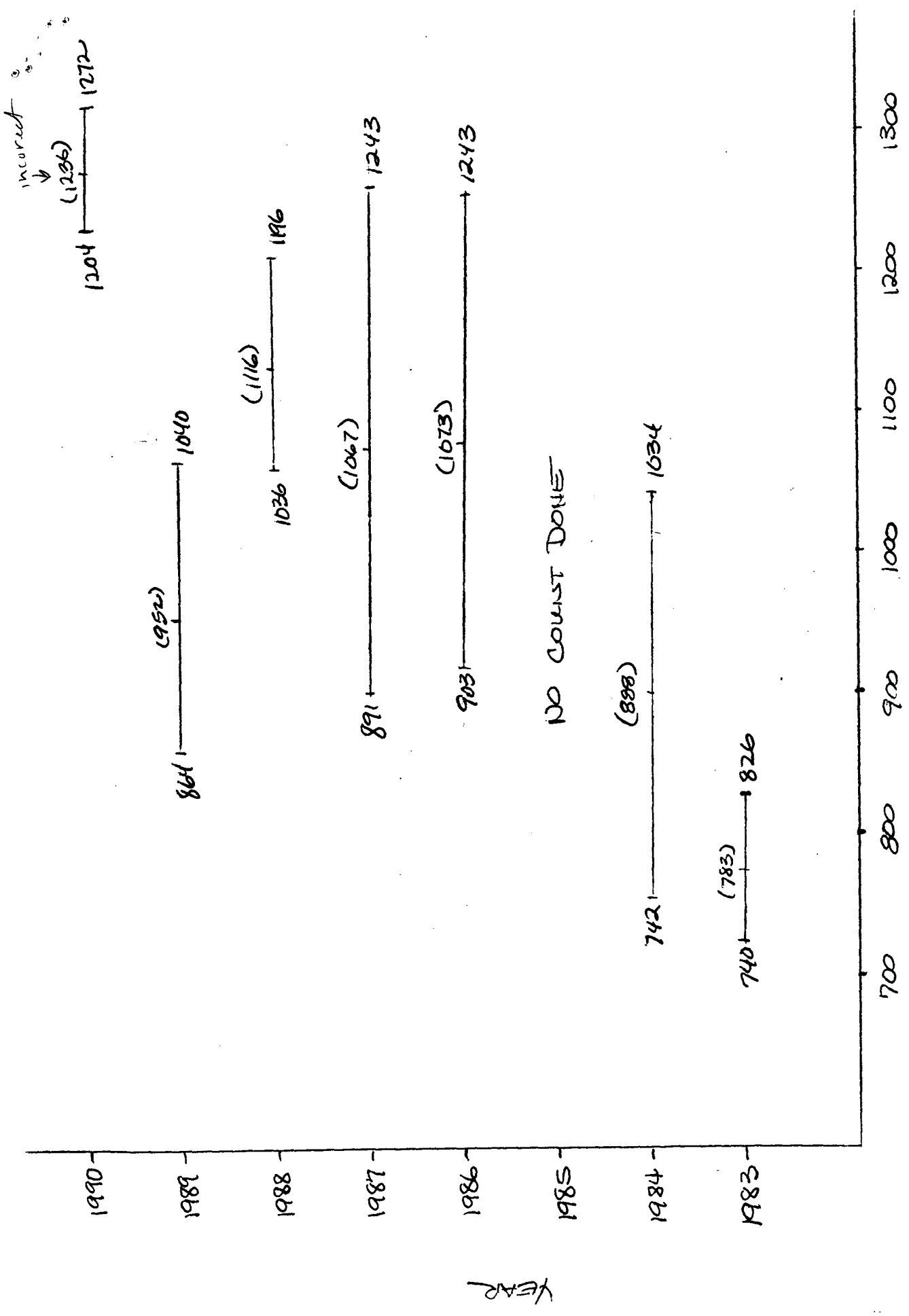
Day 2 $(1063 - 1238)^2 = -30976$ ← *Incorrect* = -30625

Day 3 $(1385 - 1238)^2 = 21609$

Day 4 $(1029 - 1238)^2 = \frac{-43681}{3596}$

95% CI = 1238 ± 1.96 (17.32) = 1204 - 1272 Deer
1238 ± 34

method. The innate cryptic behavior of the mule deer and variety of habitat systems throughout the study area would create enormous amounts of difficulty in the field to see those marked and unmarked animals. The extremes in terrain elevation, the severity of the winter season, reproductive output of the previous years and roadkills are only a few of the variables responsible for the inaccurate census counts. This last survey employed two other census methods, aerial counts and pellet-plot techniques. These methods provide a cost reduction in terms of staff time and money but would also monitor the trends in population change over time and space. At the current time these two methods have been adopted to replace the Mark-Observe technique and will prove beneficial for the intended purpose to this project.



MEANS POPULATION

TABLE 1

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