

26109
BRCA-0170

COMPARISON OF SITE FACTORS BETWEEN SUCCESSFUL
AND UNSUCCESSFUL UTAH PRAIRIE DOG
TRANSPLANT SITES

Project proposal submitted by

Dana Nall

Department of Fisheries and Wildlife Biology

Utah State University

Logan, Utah 84322-5210

1989

TABLE OF CONTENTS

Introduction.....	1
Objectives.....	2
Background Information	
History of the Utah Prairie Dog.....	3
Site Factors and Transplant Success.....	3
Proposed Research.....	6
Methods.....	8
Analysis.....	11
Work Schedule.....	11
Facilities.....	14
Personnel and Qualifications.....	14
Literature Cited.....	15
Appendices	
Appendix I - Guidelines for Selecting a Transplant Site.....	18
Appendix II - Step Down Outline.....	20

LIST OF FIGURES

- Figure 1. Past and present distribution of the Utah prairie dog.
- Figure 2. Population estimates of the Utah prairie dog from 1970 to 1988.
- Figure 3. Boundary schematic of inside and outside study areas for each transplant site.
- Figure 4. Point sighting frame used for percent cover measurements.
- Figure 5. Point frame data sheet.

LIST OF TABLES

Table 1. Site factor information needed to address objectives of Utah
prairie dog transplant site study.

INTRODUCTION

The Utah prairie dog (Cynomys parvidens) is currently listed as a threatened species on the Federal Threatened and Endangered Species List (Federal Register 1989). This listing occurred because prairie dog range and numbers were reduced due to poisoning, disease, drought, climatic changes, and habitat alterations. In 1972, the U. S. Fish and Wildlife Service and the Utah Division of Wildlife Resources initiated a trapping and transplanting program to increase prairie dog numbers on public lands. Since then, studies of site characteristics important to prairie dogs have been used to develop site selection recommendations for transplanting prairie dogs. Important site factors include vegetation (composition, condition, and arrangement), soil, topography, elevation, temperature, and precipitation.

The ability of these factors to predict successful transplant sites has not been tested. Generally, researchers have listed those factors present at established colonies while failing to describe factors that are missing from unsuccessful transplant sites. A successful transplant site is defined as a site that contains a self-sustaining or increasing population of prairie dogs whereas an unsuccessful site contains a declining or extinct population.

A comparison of these site factors at successful and unsuccessful transplant sites will provide valuable insight for selecting transplant sites for Utah prairie dogs.

OBJECTIVES

There are three objectives of this study:

- 1) Determine whether transplant success is related to site factors that are reported in literature to be important to Utah prairie dogs.

H_{01} = Successful and unsuccessful transplant sites do not differ in site factors of vegetation, soils, topography, elevation, temperature, and precipitation.

- 2) Determine whether prairie dog densities can be predicted by the density index equation derived by Crocker-Bedford and Spillett (1981) which states:

Density Index = $138.2 - (0.0472 \times \text{Elevation in meters}) + (2.16 \times \text{Percentage cool season grass canopy cover up to 20\%}) + (7.27 \times \text{Forage condition on moist area in midsummer}) - (0.073 \times \text{Average distance in meters from home burrow to moist area})$.

Forage condition on moist areas in midsummer takes the following values:

brown grasses and forbs = 0;

green grasses and forbs that are fairly dry = 1;

green grasses and forbs that are moist = 2; and

soggy ground = 3.

Density index numbers describe the mean mound distances between prairie dog mounds subtracted from 100.

- 3) Investigate through a literature search other potential causes of transplant failure such as predation, failure of prairie dogs to bond to the new transplant site, or breakdown of social organization.

BACKGROUND INFORMATION

History of the Utah Prairie Dog

In the 1920's an estimated 95,000 Utah prairie dogs ranged over nine Utah counties (Collier and Spillett 1975). Since then poisoning, disease, drought, climatic changes, overgrazing, and cultivation have reduced prairie dog distribution by over 50% (Figure 1) with a record low 3,300 animals reported in 1972 (Collier and Spillett 1973). Therefore, in 1973, the Utah prairie dog was federally listed as endangered or a species in danger of becoming extinct (U. S. Bureau of Sport Fisheries and Wildlife 1973). Anticipating this action, the Utah Division of Wildlife Resources and the U. S. Fish and Wildlife Service initiated a trapping and relocation program in 1972. The purpose of this program is to supplement the Utah prairie dog population by trapping prairie dogs on private lands and transplanting them to public lands. Following listing and protection, numbers of prairie dogs increased dramatically, mostly on agricultural lands (Figure 2) and the species was reclassified as threatened in 1984 (Federal Register 49 FR 22330). By 1988, a total of 12,803 prairie dogs had been transplanted and the population estimate for that year was 11,968. Transplanted prairie dogs suffer high mortality from predation and adverse weather especially if they disperse from the transplant site (Flinders and Jacquart 1985). Therefore, even though large numbers of prairie dogs are transplanted annually, the transplanted population increases gradually.

Site Factors and Transplant Success

After the Utah prairie dog was placed on the Threatened and Endangered Species list, several studies of habitat requirements were carried out. Flinders and Jacquart (1985) investigated the dispersal, survival of, and the

general vegetative and topographic areas used by transplanted prairie dogs. Limited to one transplant site, the study described prairie dog behavior following relocation. Studies of specific habitat features and requirements by Collier (1974,1975), Collier and Spillett (1975), Crocker-Bedford (1975,1976), Crocker-Bedford and Spillett (1981), and Hasenyager (1983) have contributed to the current understanding of how vegetation, soil, topography, elevation, precipitation, and temperature affect Utah prairie dogs. These data were synthesized into a recommended set of guidelines for selecting transplant sites (U. S. Fish and Wildlife Service 1988; Appendix I). Although potentially important to prairie dog management, these guidelines have not been validated in field studies.

Initial transplant efforts involving large numbers of prairie dogs had limited success due to high mortality. Therefore focus of the transplant efforts shifted to improving the survival of transplanted animals. Site preparation practices, such as vegetative manipulation and augering shallow holes in the ground to provide temporary security, improved transplant success (Utah Division of Wildlife, unpubl. data). However, some sites still failed to support self-sustaining populations of prairie dogs. To date, over half of the approximately 40 transplant sites are considered unsuccessful and often for unknown reasons.

To answer the question why these sites were unsuccessful the U. S. Fish and Wildlife Service recognized the need to compare successful and unsuccessful transplant sites. In their Utah Prairie Dog Recovery Plan (U. S. Fish and Wildlife Service 1988) they outline specific steps necessary to meet this objective. The outline recommends comparing the vegetation (composition, percent cover, and visibility); soil (type, color, and depth); topography; elevation; temperature (long-term monthly averages and extremes); and

precipitation (long-term monthly and annual averages) of successful and unsuccessful transplant sites (Appendix I).

Much of the literature on Utah prairie dogs emphasizes the importance of vegetation (Collier 1974, 1975; Collier and Spillett 1975; Crocker-Bedford 1975, 1976; Crocker-Bedford and Spillett 1981; Hasenyager 1983). Vegetative composition, production, and cover provide food and influence security. Prairie dogs seem to prefer swale areas where moist vegetation is available even during dry periods (Crocker-Bedford and Spillett 1977). If vegetation becomes too high or too dense, visibility is impaired and prairie dogs will abandon the site (Koford 1958, Crocker-Bedford 1975).

Soils are another important habitat component. Soils must be well-drained and deep enough to allow burrowing to depths sufficient to provide protection from predators and insulation from environmental and temperature extremes (Mike Coffeen, Utah Division of Wildlife Resources, pers. commun.). In addition, soil color may help camouflage prairie dogs to reduce their visibility to avian and terrestrial predators (Collier 1975).

Topography also influences visibility and burrowing as well as vegetation. Elevation, temperature, and precipitation affect vegetation and over-winter survival. As elevation increases, temperatures decrease, and amount and duration of snowpack increase to create colder conditions over a longer period of time. This increases winter energy demands of prairie dogs, delays reproduction, and shortens the growing season for both prairie dogs and the vegetation they feed on.

PROPOSED RESEARCH

The first objective of this study is to determine how site factors differ between successful and unsuccessful transplant sites. This objective addresses a portion (Appendix II) of the Utah Prairie Dog Recovery Plan Outline (U. S. Fish and Wildlife Service 1988) of steps necessary to recover and delist this species. An increased understanding of how site factors influence potential transplant success will reduce the chances of prairie dogs being released onto potentially unsuccessful sites. To meet this objective all transplant sites will need to be studied due to the number of variables involved in relation to the number of transplant sites. Transplant sites are located on lands managed by Bryce Canyon National Park, Bureau of Land Management, Dixie National Forest, Fishlake National Forest, and the State of Utah. I will contact all of these agencies to coordinate field research and to receive any necessary permits. At the end of each field season an annual report and field notes will be submitted to each agency. Herbarium and soil samples collected in Bryce Canyon National Park will be cataloged using their numbers and will be given to the park when research is completed. All other samples will be cataloged and stored at Utah State University.

The second objective is to determine if prairie dog densities can be predicted by a density index equation derived by Crocker-Bedford and Spillett (1981) which states:

$$\text{Density index} = 138.2 - (0.0472 \times \text{Elevation in meters}) + (2.16 \times \text{Percent cool season grass canopy cover up to 20\%}) + (7.27 \times \text{Forage condition on moist areas in midsummer}) - (0.073 \times \text{Average distance in meters from home burrows to moist area}).$$

To meet these first two objectives I will need to collect the information listed in Table 1. An analysis of this data in relation to transplant success will indicate the relative importance of these site factors to Utah prairie dogs as well as testing the validity of the density index equation.

The third objective is to do a literature search to investigate other potential causes of transplant failure such as predation, disease, harassment, failure of prairie dogs to bond to a site, or failure of prairie dogs to re-establish social structures.

Meeting these objectives will benefit the Utah prairie dog, the trapping/transplant program, and the threatened and endangered species program because: 1) manpower and dollars used for site preparation and transplanting can be focused on sites most likely to be successful (increasing efficiency and reducing prairie dog mortality); 2) if site factors are useful predictors of prairie dog density, priority can be given to sites capable of supporting larger numbers of prairie dogs (larger colonies are more stable and elastic); 3) delisting the Utah prairie dog as a threatened species by reaching minimum viable population targets sooner would release dollars for other threatened and endangered species and allow control of prairie dogs causing agricultural damage; and 4) a "success story" would be positive reinforcement for the Threatened and Endangered Species Program and would improve public relations for the Utah Division of Wildlife Resources. Public attitude toward the Utah prairie dog program is generally negative due to agricultural damage caused by these animals.

The study area for this project is the current range of the Utah prairie dog (Figure 1) within which lie approximately 40 transplant sites.

METHODS

For each transplant site I will obtain the information listed in Table 1.

Vegetation

Initially, I will need to determine whether prairie dogs have significantly altered the vegetation within the transplant site by sampling vegetation both within and outside the colony boundary. If differences are found, then data from the area outside the colony should provide approximate transplant conditions prior to prairie dog release. If there is no significant difference in vegetation within and outside the colony, then vegetation estimates from within the colony will be used for objectives 1 and 2 because they represent the community prairie dogs are actually using. A line connecting all home burrow mounds will delineate the colony boundary (Figure 3). While foraging, Utah prairie dogs rarely travel more than 400 m from their home burrows (Crocker-Bedford 1975), therefore, a 400-m distance from the colony boundary will delineate the interior boundary of the outside area. Transects for the outside area will originate from this boundary at random points. I will stratify each area to eliminate from sampling areas that are unsuitable for prairie dogs such as extremely densely vegetated areas, very rocky surfaces, cliffs, gullies, ponds, bogs, or forest. Next, I will randomly establish twenty 20-m transect lines within each area and permanently mark these lines to repeat measurements.

where in
BPCA will
this be
done

Vegetative measurements will be made in the late spring/early summer and repeated midsummer to late summer to get a representative sample of cool and warm season plants. I will collect a voucher specimen for each species, assign

it a 3-digit identification number, and verify identification at the Intermountain Herbarium at Utah State University.

I will obtain percent cover measurements of grasses, forbs, and shrubs using the point intercept method (Levy and Madden 1933) and a frame designed by Floyd and Anderson (1982). This 0.5 X 1-m frame has a double sighting grid consisting of 36 points at 10-cm intervals (Figure 4). This frame will be centered over 6 randomly chosen meters of each transect line with its long axis parallel to the line. I will record plant species, litter, bare ground, rock, lichen, moss, or dead shrub sighted under each point onto a point frame data sheet (Figure 5). The number of points recorded for each will give an estimate of percent cover when divided by the total number of points sampled. One hundred and twenty 36-point sampling frames will be obtained from both the inside and outside sampling areas for each transplant site. This will give a representative sample of cover for grasses, forbs, and shrubs (Floyd and Anderson 1987).

Preferred forage species of the Utah prairie dog (Crocker-Bedford and Spillett 1981; Hasenyager 1983; and Mackley, Flinders, and Whisenant, 1989) will be clipped, dried, and weighed to determine biomass. Samples will be taken from 10 randomly located $1/2\text{-m}^2$ plots. As percent cover and biomass data are collected, I will rank the condition of the vegetation on a scale of 0-3 which is similar to that used by Crocker-Bedford and Spillett (1981) where,

- 0 = brown and dry,
- 1 = green but dry,
- 2 = green and moist,
- 3 = growing on soggy ground.

I will use a cover board to determine visibility for Utah prairie dogs using a cover board and periscope set to view 20 cm above the ground

Where in
BREA will
this work
occur? We
need to make
sure it
doesn't
conflict w/
fire
transects

(approximate height of a prairie dog sitting up). Measurements will be taken at 10, 50, and 100-m distances in a random direction from every other sampling line. The number of squares on the cover board obstructed from view will provide an estimate of visibility.

Soils

Information on soils in Utah is available from the Soil Conservation Service, U. S. Forest Service, and Bureau of Land Management. From these records I will obtain the necessary data on soil type and depth. A soil sample will be taken from each area to verify these records. Soil color charts will be used to determine soil color. Information on old mounds will be obtained from the Utah Division of Wildlife Resources records and on-site observations. On each transect line, the distance from each mound on the line to the nearest mound will be measured to obtain an estimation of the average distance between mounds and mound density.

Topography and Elevation

I will obtain information on slope and aspect using a clinometer and compass. Elevation will be taken from U. S. Geological Survey 7.5 minute topographic maps. Distances from home burrows to moist areas will be estimated (where applicable) by measuring the distance from the center of the colony to the moist area.

Precipitation and Temperature

The U. S. Department of Commerce and U. S. Weather Bureau have long-term records which I will use to get information on precipitation and temperature for weather stations closest to each transplant site.

ANALYSIS

To determine if transplant success is related to site factors (Objective 1) I will use a logit model (Fienberg 1980) to analyze vegetation, soils, topography and elevation data. Precipitation and temperature data will not be included in this analysis because the relationship between transplant site weather conditions and those conditions present at the weather station is unknown. Not including these data will also reduce the number of variables run in the logit model. However, this information will be collected and plotted for each transplant site to see if consistent patterns emerge.

To address objective 2, values obtained within and outside the colonies will be used in Crocker-Bedford and Spillett's equation (1981) to determine the expected density index. The result of each run will be compared to the observed mound density measured at each site using a chi-square test to determine if the expected values are significantly different from the observed values and at what level of significance.

WORK SCHEDULE

Year 1 - 1988-1989

Fall

- 1) Coursework at Utah State University
- 2) Write and re-write proposal
- 3) Select committee members

Winter

- 1) Coursework at Utah State University

- 2) Pre-project seminar
- 3) Defense of proposal
- 4) Revise proposal as necessary
- 5) Application for candidacy

Spring

- 1) Agency work for Fishlake National Forest
- 2) Initial evaluation of all transplant sites (locations and success)
- 3) Schedule sampling (coordinate with field assistant(s))
- 4) Begin early season site sampling (May-June)

Summer

- 1) Agency work for Fishlake National Forest
- 2) Finish early season site sampling (June)
- 3) Begin and finish late season site sampling (August-September)
- 4) Attend Ad Hoc Prairie Dog Recovery Team Meeting

Year 2 - 1989-1990

Fall

- 1) Coursework at Utah State University
- 2) Review project with committee members, U. S. Forest Service, U. S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, and Utah Division of Wildlife Resources
- 3) Revise field techniques if necessary
- 4) Initial data analysis
- 5) Collect information on soils, temperature, and precipitation
- 6) Identify and catalog voucher specimens collected
- 7) Measure dry weights of vegetation collected

Winter

- 1) Coursework at Utah State University

- 2) Continue Fall 1989 items 4) - 7)

Spring

- 1) Agency work for Fishlake National Forest
- 2) Begin early season site sampling (May)

Summer

- 1) Agency work for Fishlake National Forest
- 2) Continue early season site sampling (June)
- 3) Begin and finish late season site sampling (August-September)
- 4) Attend Ad Hoc Prairie Dog Recovery Team Meeting

Year 3 - 1990-1991

Fall

- 1) Coursework at Utah State University
- 2) Review project (see Fall 1989 item 2)
- 3) Identify and catalog voucher specimens collected
- 4) Measure dry weights of vegetation
- 5) Begin final data analysis

Winter

- 1) Finish coursework at Utah State University
- 2) Finish data analysis
- 3) Begin writing thesis

Spring

- 1) Finish writing thesis
- 2) Post-project seminar
- 3) Defense of thesis
- 4) Graduation from Utah State University

FACILITIES

As a cooperative education biologist for the U. S. Forest Service a wide variety of facilities and services are available for use on this project.

These include:

- 1) Access to all public land transplant sites and location information for each site.
- 2) Access to resource inventories and maps from the U. S. Forest Service, Bureau of Land Management, U. S. Fish and Wildlife Service, and the Utah Division of Wildlife Resources.
- 3) Use of a four-wheel-drive truck.
- 4) Access to the U. S. Forest Service Data General Computer System (a nation-wide network).
- 5) Access to vegetation, soils, and topography sampling equipment.

PERSONNEL AND QUALIFICATIONS

With the assistance of a field technician I will conduct all field studies. My qualifications for this project include:

- 1) A nine month assignment as the technician for the Utah Prairie Dog Project in 1987. Duties included trapping and transplanting Utah prairie dogs, cooperation with federal land management agencies regarding site selection, transplant site monitoring, mapping of transplant sites, presenting member at Ad Hoc Prairie Dog Recovery Team Meeting, compiling project data and writing annual trapping/transplant report, predator control, and equipment inventory.

- 2) Strong undergraduate background in range science.
- 3) Positive working relationships with all agencies involved in the Utah prairie dog recovery effort.

LITERATURE CITED

- COLLIER, G. D. 1974. Effects of environmental factors on the Utah prairie dog. Unpubl. doctoral dissertation. Utah State University, Logan, UT. 96 pp.
- COLLIER, G. D. 1975. The Utah prairie dog: Abundance, distribution, and habitat requirements. Utah Div. Wildl. Resour. Bull. No. 75-10. 108 pp.
- COLLIER, G. D. and J. J. SPILLETT. 1973. The Utah prairie dog--decline of a legend. Utah Sci. 34:83-87.
- COLLIER, G. D. and J. J. SPILLETT. 1975. Factors influencing the distribution of the Utah prairie dog (Cynomys parvidens). Southwest. Nat. 20:151-158.
- CROCKER-BEDFORD, D. C. 1975. Utah prairie dog habitat evaluation. Utah Wildl. Soc. Tech. Mtg. Salt Lake City. Feb. 21, 1975.
- CROCKER-BEDFORD, D. C. 1976. Food interactions between Utah prairie dogs and cattle. Unpubl. M.S. thesis, Utah State University, Logan, UT. 131 pp.
- CROCKER-BEDFORD, D. C. and J. J. SPILLETT. 1977. Home ranges of the Utah prairie dog. J. Mammal. 58:672-673.
- CROCKER-BEDFORD, D. C. and J. J. SPILLETT. 1981. Habitat relationships of the Utah prairie dog. U. S. Government Publ. No. 1981-0-677-202/4 prepared under U. S. Fish and Wildlife Service contract No. 14-16-0008-1117 through Utah Coop. Wildl. Research Unit, Logan, UT. 29 pp.
- FEDERAL REGISTER. 1984. Vol. 49, No. 104,22330.

- FEDERAL REGISTER. 1989. Endangered and threatened wildlife and plants. 50CFR 17.11 and 17.12. Jan. 1, 1989.
- FIENBERG, S. 1980. The analysis of cross-classified categorical data. MIT Press, Cambridge, MA. 198 pp.
- FLINDERS, J. T. and H. C. JACQUART. 1985. Monitoring transplanted populations of the Utah prairie dog (Cynomys parvidens). Unpubl. Rep. submitted to Utah Div. Wildl. Resour. 48 pp.
- FLOYD, D. A. and J. E. ANDERSON. 1982. A new point interception frame for estimating cover of vegetation. Vegetatio 50:185-186.
- FLOYD, D. A. and J. E. ANDERSON. 1987. A comparison of three methods for estimating plant cover. J. Ecology 75:221-228.
- HASENYAGER, R. N. 1983. Diet selection of the Utah prairie dog (Cynomys parvidens) as determined by histological fecal analysis. Utah Div. Wildl. Resour. Rep. submitted to U. S. Fish and Wildl. Serv. Coop. Res. Unit, Logan, UT. 32 pp.
- KOFORD, C. B. 1958. Prairie dogs, whitefaces, and blue grama. Wildl. Monogr. 3:1-78.
- LEVY, E. B. and E. A. MADDEN. 1933. The point method of pasture analysis. N. Z. J. Agric. 46:267-279.
- MACKLEY, J. W., J. T. FLINDERS, and S. G. WHISENANT. 1989. The diet and forage selection of the Utah prairie dog (Cynomys parvidens) in natural areas of John's Valley, Garfield County, Utah. Unpubl. Rep. submitted to Dept. of Botany and Range Sci., Brigham Young University, Provo, UT. 8 pp.
- U. S. BUREAU OF SPORT FISHERIES AND WILDLIFE. 1973. Threatened wildlife of United States. U. S. Gov. Print. Off., WASH, D. C. 289 pp.
- U. S. FISH AND WILDLIFE SERVICE. 1988. Utah prairie dog recovery plan

(draft). Prepared in cooperation with the Utah Division of Wildlife
Resources. U. S. Fish and Wildl. Serv., Denver, CO. 69 pp.

APPENDIX I - GUIDELINES FOR SELECTING A TRANSPLANT SITE

Taken from Utah Prairie Dog Recovery Plan (U. S. Fish and Wildlife Service 1988).

1. The area must be well-drained. A prairie dog must be able to inhabit a burrow system 1 meter underground in an area at any time without becoming wet.
2. The soil in the burrow area must not easily cave in. The soil must not be sand or loamy sand.
3. The elevation of the transplant site must be within 305 meters of the elevation of the capture site if transplanted animals are allowed to interact with established colonies. This assures that the physiologically set dates of important functions, such as arousal from hibernation and beginning of parturition, coincide with environmental constraints.
4. The site should be ranked higher if it has evidence of old mound systems.
5. Prairie dogs should not be relocated to a site with an existing viable prairie dog colony.
6. Sites should be located far enough from other transplant sites and established colonies to prevent interactions.
7. The site should not have vegetation dense and high enough that it prohibits prairie dogs from seeing through or over it.
8. Green vegetation in the form of grasses, forbs, and shrubs must be available throughout the period of Utah prairie dog activity above ground. Green vegetation is particularly essential in drought years and in dry months of June through August.

Because of the importance of providing sites with the proper vegetation, specific recommended vegetative parameters are suggested:

	<u>Recommended Range (%)</u>	<u>Minimum</u>	<u>Maximum</u>
Total canopy cover	25-45	20	85
Cool season grasses *	20-40 at 1,890 meters	0	70
	1,891-2,590 meters	1-15	70
	2,591 meters-above	5-15	70
Warm season grasses	5-10	0	40
Forbs	5-15	0 **	40
Shrubs (other than rabbitbrush)	0-15	0 **	15
Rabbitbrush	1-3	0 **	15

* The minimum requirements for cool season grasses vary with different elevations.

** Some flowers and seeds of dicots must be available from mid-June to September, but it doesn't take many flowers to feed a population of prairie dogs.

APPENDIX II - STEP DOWN OUTLINE

Taken from Utah Prairie Dog Recovery Plan (U. S. Fish and Wildlife Service 1988).

3. Determine what factors influence the viability of an established colony.

31. Survey active towns.

311. Conduct vegetative sampling.

3111. Determine types of communities.

3112. Determine biological requirements.

3113. Determine visibility necessary.

312. Document elevation.

313. Document annual/monthly precipitation.

3131. Determine long-term annual average.

3132. Determine long-term monthly average.

314. Document temperature extremes/average.

3141. Determine 10-year monthly average.

3142. Determine 10-year monthly extremes.

315. Document slope and aspect.

316. Determine soil characteristics.

3161. Determine type.

3162. Determine coloration.

3163. Determine depth.

32. Survey successful transplant sites (as outlined in tasks 311 to 316).

33. Survey unsuccessful transplant sites (as outlined in tasks 311 to 316).

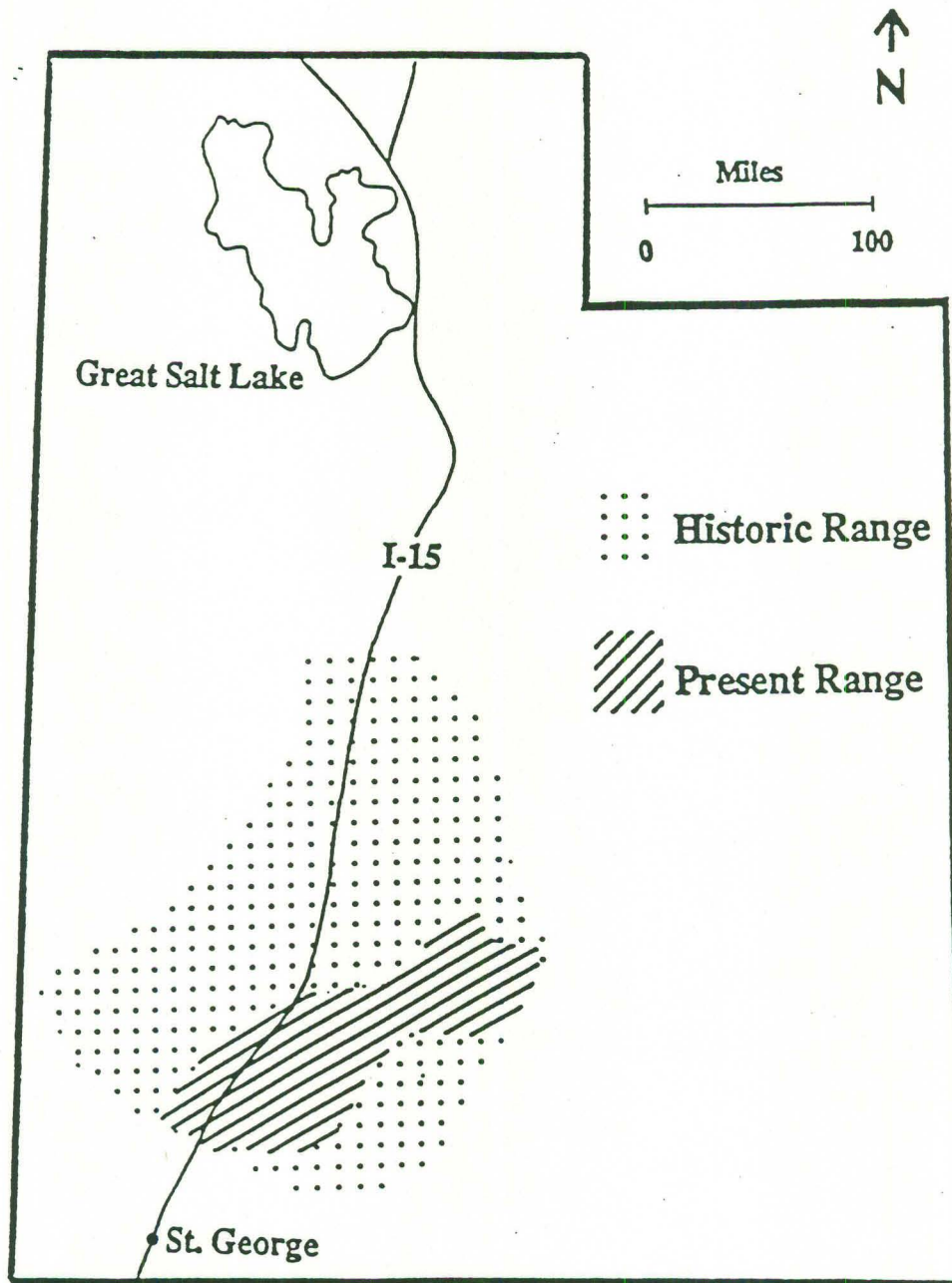


Figure 1. Past and present distribution of the Utah prairie dog.

POPULATION ESTIMATES

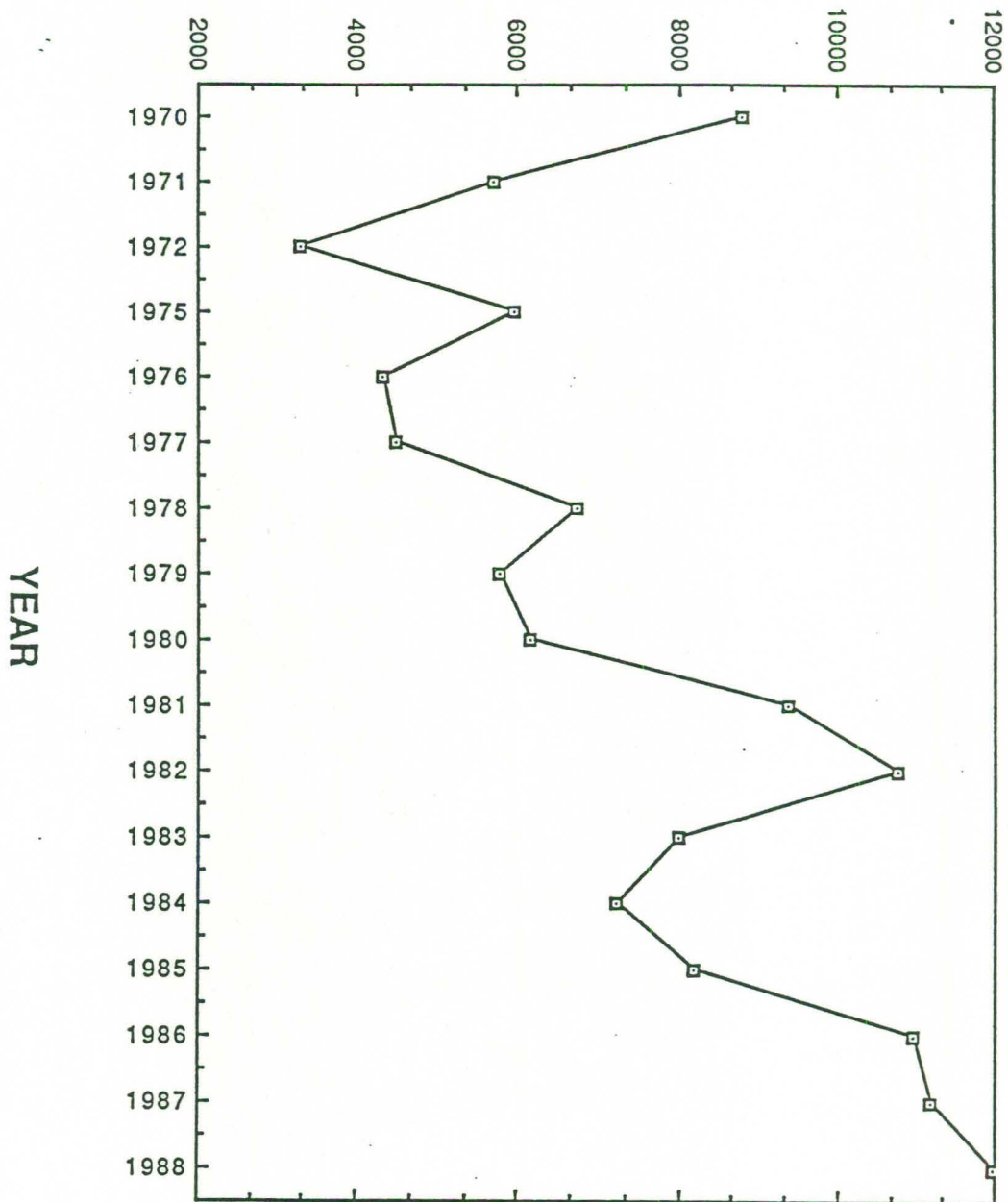


Figure 2. Population estimates of the Utah prairie dog from 1970 to 1988.

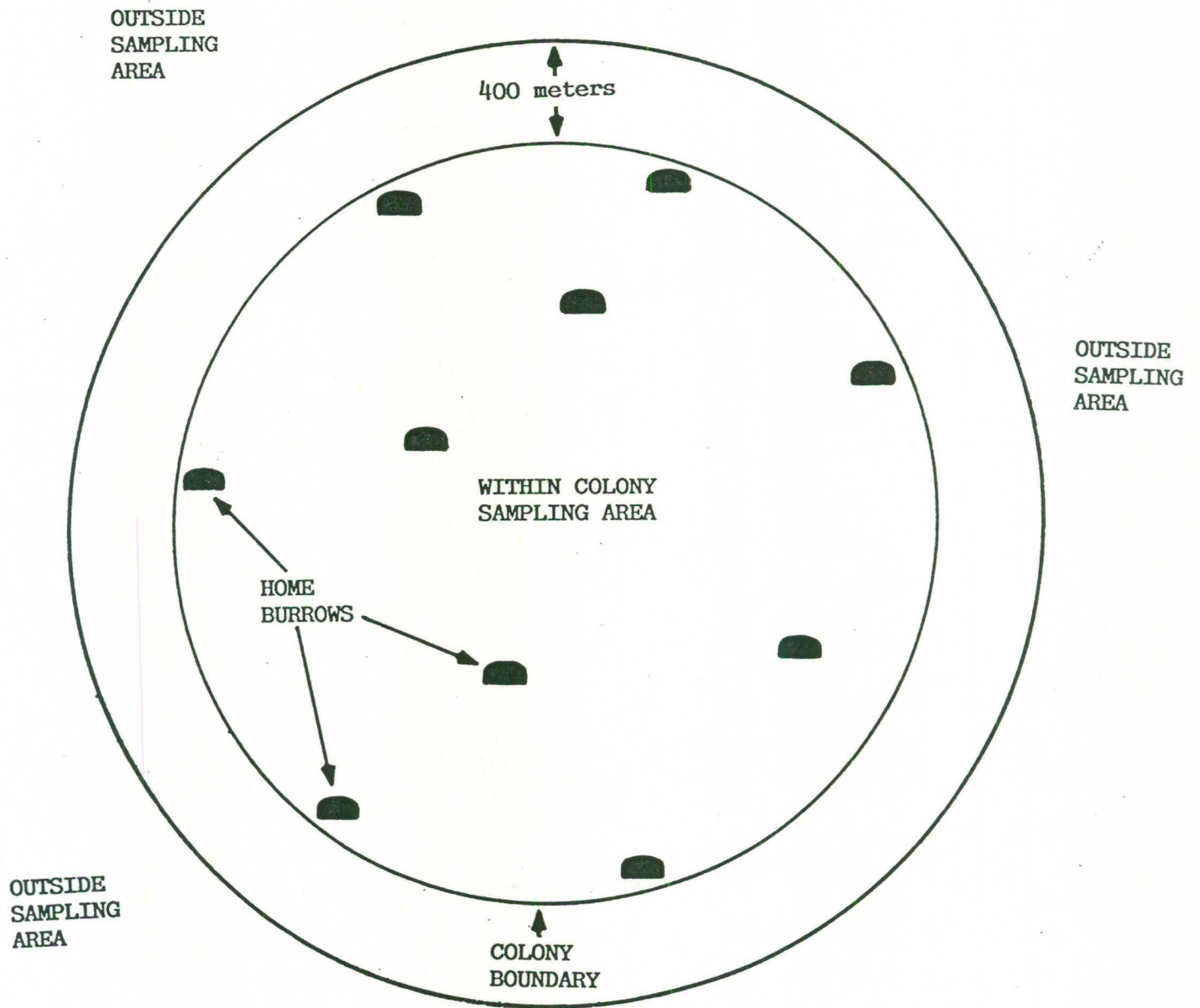


Figure 3. Boundary schematic of inside and outside study areas for each transplant site.

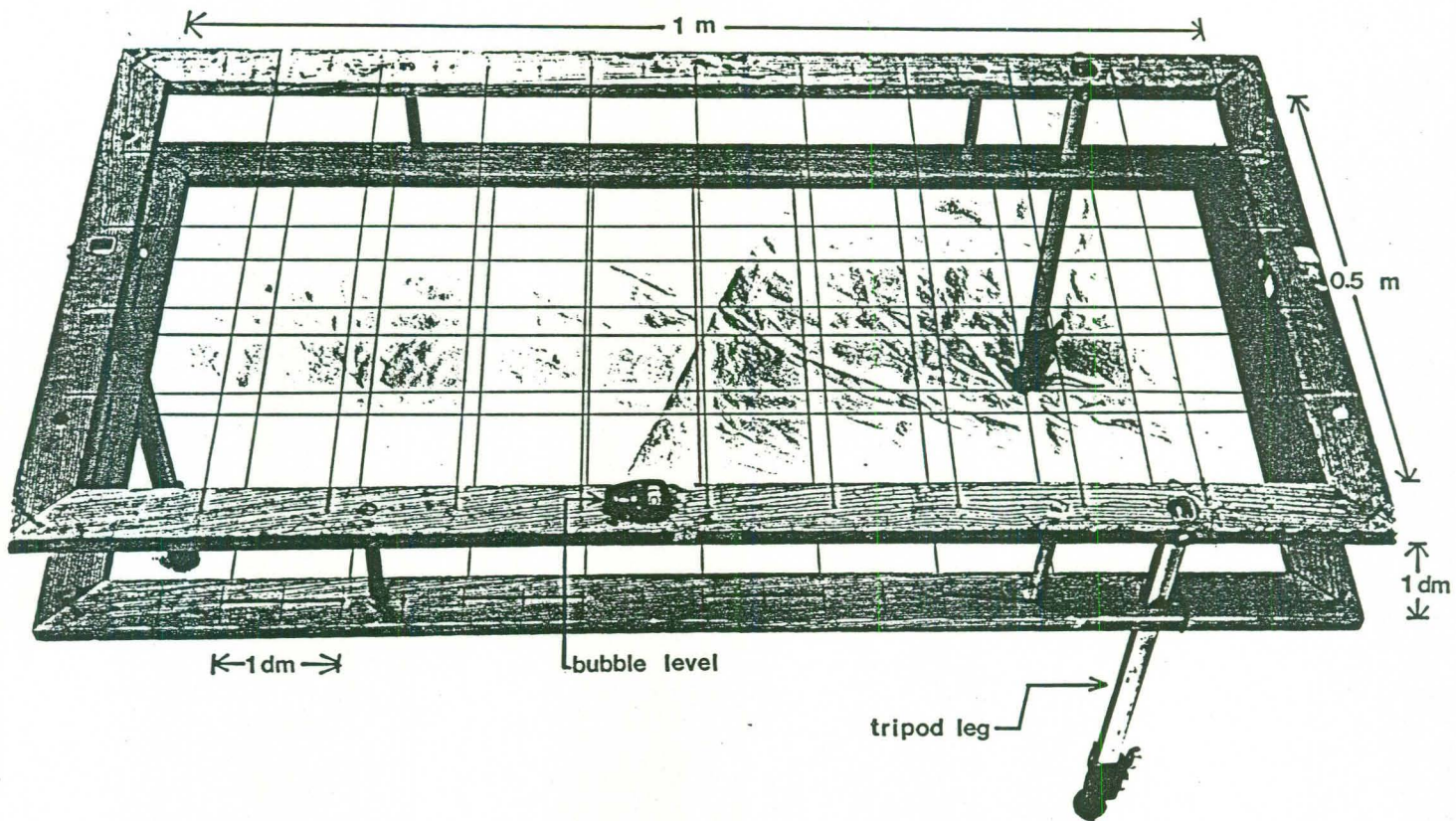


Figure 4. Point sighting frame used for percent cover measurements.

POINT FRAME DATA SHEET

Transplant Site: _____ Township: ____ Range: ____ Section: ____

Transect #: _____

Date: _____

Observer(s): _____

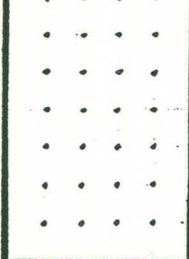
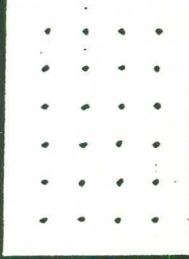
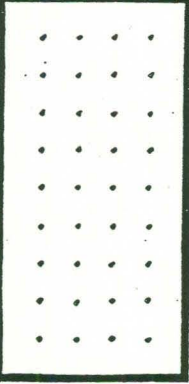
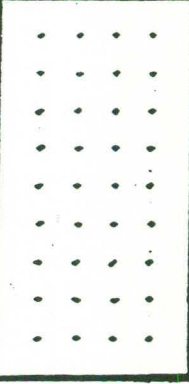
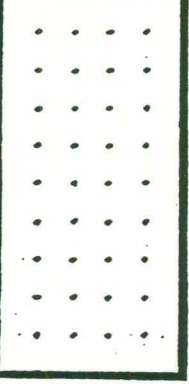
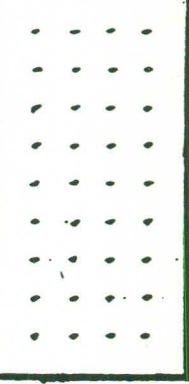
B = Bare ground L = Litter R = Rock M = Moss LN = Lichen DS = Dead Shrub		FRAME # _____ <u>Symbol</u> <u>Species</u>		FRAME # _____
<u>NOTES</u>		FRAME # _____		FRAME # _____
		FRAME # _____		FRAME # _____

Figure 5. Point frame data sheet.

Table 1. Site factor information needed to address objectives of Utah prairie dog transplant site study.

Site Factor	Data Needed	Objective Addressed
Vegetation	Percent Cover	1 and 2
	-cool season grasses	1 and 2
	-other grasses	1
	-forbs	1
	-shrubs	1
	Forage Biomass	1
	Vegetative Composition	1
	Vegetative Condition	1 and 2
	Visibility	1
Soil	Type	1
	Depth	1
	Color	1
	Evidence of Old Mounds	1
	Distance Between Mounds	2
Topography	Slope	1
	Aspect	1
	Distance from home burrow to moist area	2
Elevation	Transplant site	1 and 2
Temperature	15-year Monthly Averages	1
	15-year Monthly Extremes	1
Precipitation	15-year Annual Averages	1
	15-year Monthly Averages	1