Technical Report No. 96

DISPERSION AND DISPERSAL OF WHITE-TAILED AND BLACK-TAILED JACKRABBITS, PAWNEE NATIONAL GRASSLANDS

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GRASSLAND BIOME

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ABSTRACT

Dispersion, dispersal, and density were measured on populations of black-tailed (*Lepus californicus*) and white-tailed (*Lepus townsendii*) jackrabbits on a 10.75 sq mile area of native short-grass prairie. All mammal scientific names used in this report are from *The Mammals of North America* by E. R. Hall and K. R. Kelson (1959). Dispersion information was obtained from a tagging-recapturing program and spotlight counts. Sample size amounted to 136 tagged hares. Black-tails outnumbered white-tails 3 to 1 and occupied most of the study area. White-tails occupied a smaller range, mostly overlapping the black-tailed jackrabbit range. Dispersal was measured by a radio telemetry technique which allowed remote monitoring of instrumented hare locations. Individuals of both species exhibited ovate occupation areas (of approximately 640 acres) which did not appear to change in size or location from season to season. Of 28 hares instrumented, six remained active, 14 were lost from radio contact, and eight died from various causes. Density was estimated from counts made on 4.25 sq mile drive plots. The spring (April) and fall (November) counts indicated 33 hares per sq mile and 93 hares per sq mile, respectively. Aerial mapping of hare tracks in snow revealed the greatest hare activity in low shrubby areas with activity gradually diminishing toward higher open grassy areas. Trapping and telemetry failed to show correlation between hare distribution and pastures grazed by cattle at light, moderate, and heavy intensities.

33 - 93 /mi²
= .1274 - .3591/ha @ 259 ha/mi²

w.t.: .03185 - .08977/ha
B.t. .09556 - .2693/ha

INTRODUCTION

Black-tailed (*Lepus californicus*) and white-tailed (*Lepus townsendii*) jackrabbits are medium-size primary consumers in the grassland ecosystem. All mammal scientific names used in this report are from *The Mammals of North America* by E. R. Hall and K. R. Kelson (1959). Hares compete with domestic livestock for food, influence the dynamics of range vegetation, are staple foods for several secondary consumers, particularly bobcats (*Lynx rufus*), coyote (*Canis latrans*), and large birds of prey, and are rapidly utilized by decomposers. A well known feature of most rabbit populations is their periodic and occasionally dramatic fluctuation in annual density. Annual density changes, mostly estimated but some measured with considerable sensitivity, of 2-3 fold are apparently common, and black-tailed jackrabbits have been known to reach local densities of 10,000 rabbits per sq mile. Since jackrabbits tend to be more mobile than either cottontail rabbits (*Sylvilagus* spp.) or prairie dogs (*Cynomys* spp.), they may respond to local seasonal environmental changes by alternately concentrating and dispersing within a given range.

Because they are wide ranging, and because of their periodic and occasionally dramatic fluctuations in density, this important segment of the primary consumers continuously fluctuates through a wide range of densities and hence through a wide range of changes in biomass, potential energy tied up in that trophic level, and rate of energy flow from lower and to higher trophic levels.

The mechanics of density change, dynamics of competition, energy budgets, and impact on higher and lower trophic levels caused by the density changes

of these primary consumers are largely unknown. This study initially proposed to measure density, dispersal, and dispersion for the species and, with information from simultaneous studies on food habits (Hansen et al. 1969), and nutrition, to determine the role of the species in the functioning of the grassland ecosystem.

STUDY AREA

The study area lies within the Central Plains Experimental Range portion of the Pawnee Site. The specific area of interest covers 6,880 acres. The Pawnee Site has been described in detail by Jameson et al. (1969).

METHODS

Hares are live trapped, tagged, and released continuously from June through September and for 2-week trap periods in other months. Traps are placed in a 0.25-mile grid (micro-grid) pattern within the Pawnee Site (Fig. 2) and in a loose grid (macro-grid) pattern over the remainder of the jackrabbit investigation area.

Trapped hares are ear tagged and color coded with a dual combination from five different fluorescent color markers. Each combination of ear markers designates the area in which the hare was originally trapped (Fig. 3). Observations of marked hares are used to determine seasonal movements and population density indices. Several mathematical techniques will be used to calculate multiple-recapture tag-ratio density indices. Total-density estimates are calculated by flushing hares from four randomly chosen plots, .25 mile

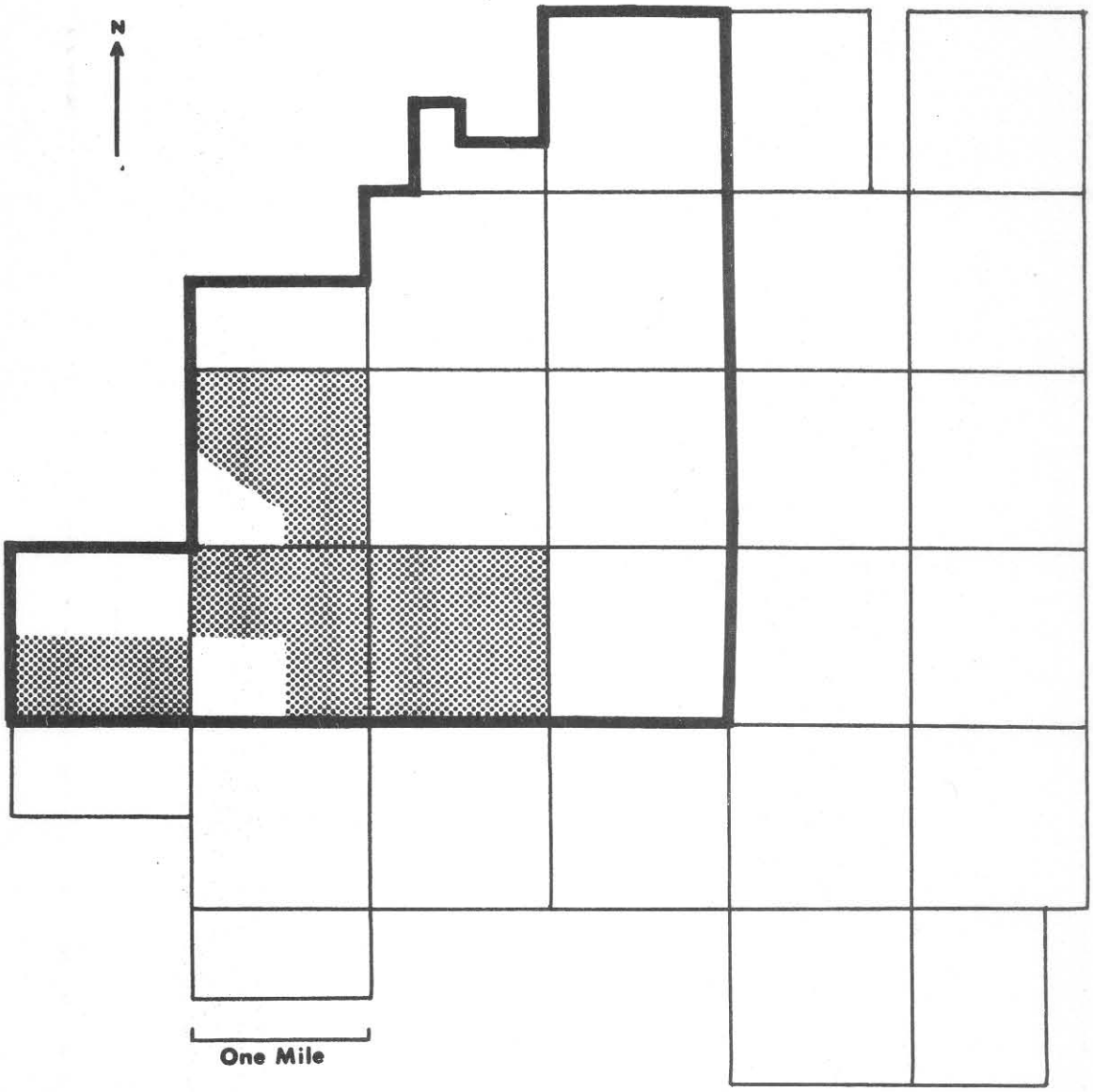

Fig. 1. Study Area.

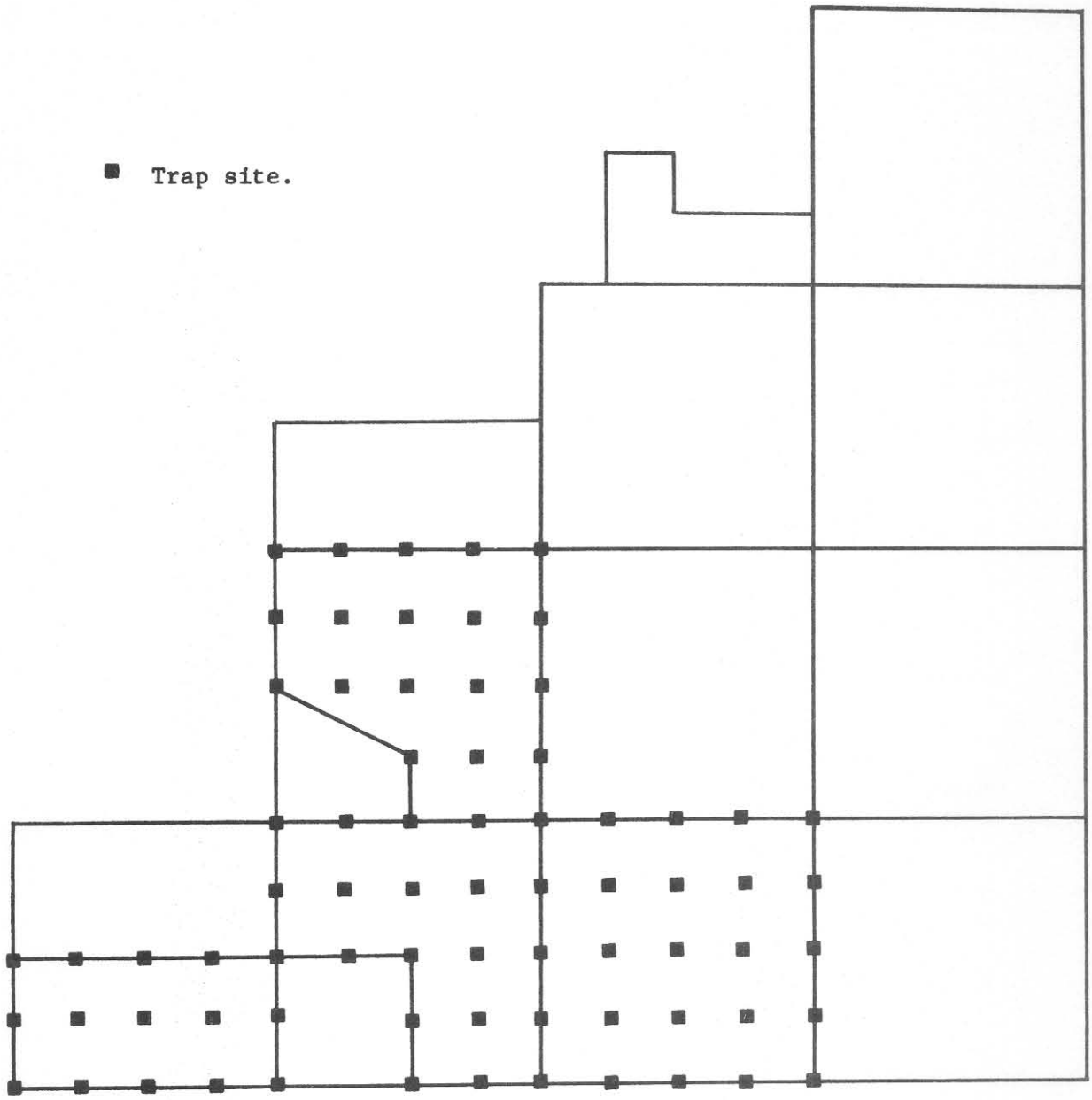

Fig. 2. Trap micro-grid.

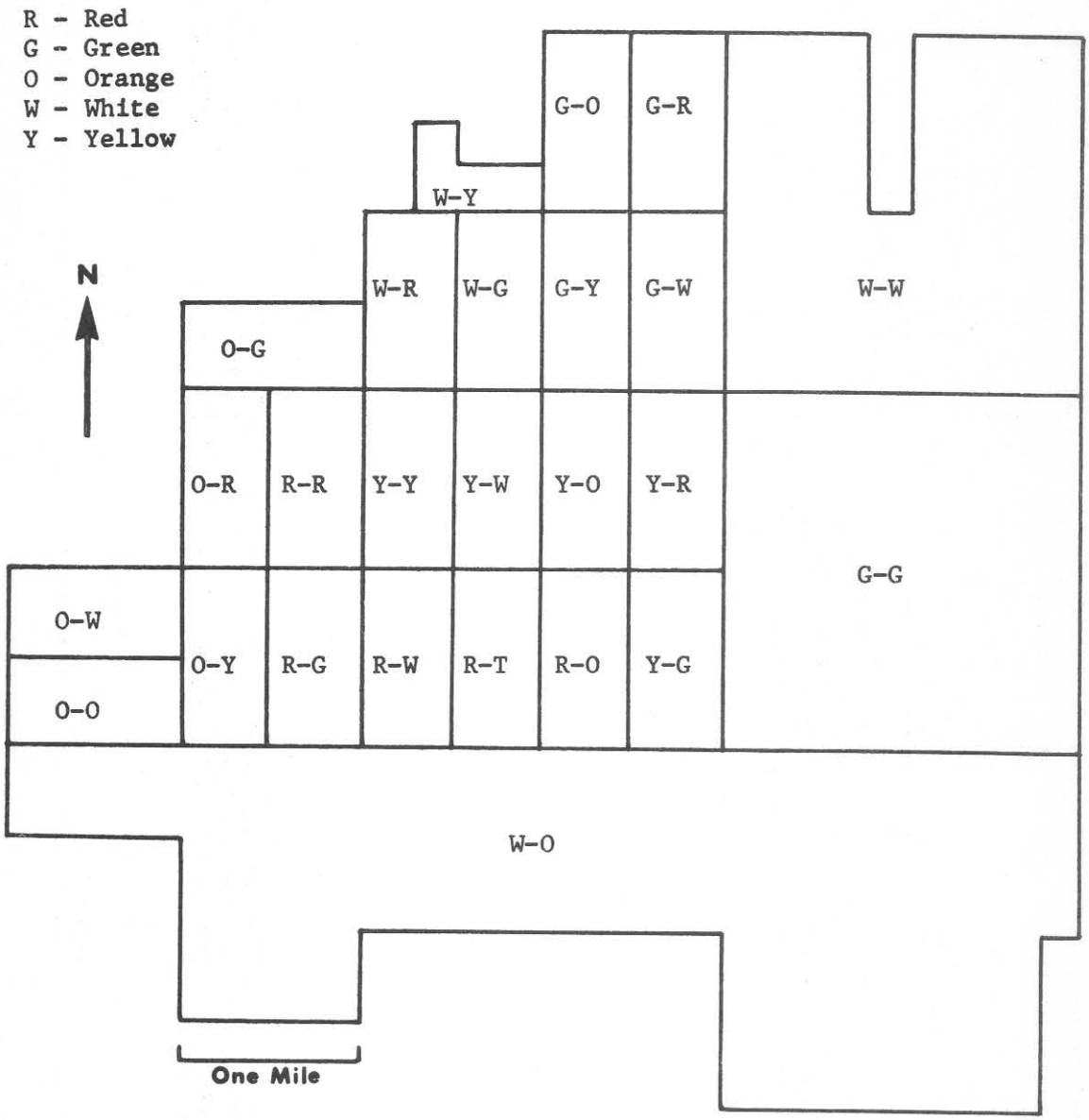

Fig. 3. Jackrabbit Ear Marker Color Code.

wide by 1 mile long within the study area. Hares are flushed by a line of drivers who walk each plot (Fig. 4).

Temperature-sensitive radio transmitters (Stoddard 1970) are used to determine movement patterns and to pinpoint mortality locations. Two receivers (with hagi antennae on stationary 70 ft towers) are located 1.25 miles apart and atop the two most prominent hills in the area. Triangulation bearings from these receivers are used to locate transmitters. A portable battery-operated receiver with directional loop antenna is used for pinpointing transmitter locations after general locations are established by triangulation.

Several tests were made during each tracking session to check the location accuracy of telemetry equipment and operators. A test transmitter was moved to different locations for each test, and the operators had no advance knowledge of its location. Each test resulted in bearings within ±3° of the actual location of the test transmitter. Hares have been located up to 4.75 miles from the permanent receivers.

Blind areas (areas out of line of sight) from each permanent antenna were mapped (Fig. 5). In theory, radio transmissions travel in a relatively straight line. Actual field tests indicate that radio transmissions bend slightly around obstacles. Only prominent elevators such as the antenna-based hills and Owl Creek ridge produced transmission blind spots.

Bearings within 5° of the base line (imiginary line drawn between the two antennae) can produce unacceptable locations.

The combination of blind areas, distance (5 miles), and base line inaccurateness lead to the designation of work areas in which telemetry locations are considered acceptable (Fig. 6). Locations plotted outside of these work areas are discarded.

Fig. 4. Drive plots (numbered rectangles) total one square mile and cover 9.3 percent of the study area.

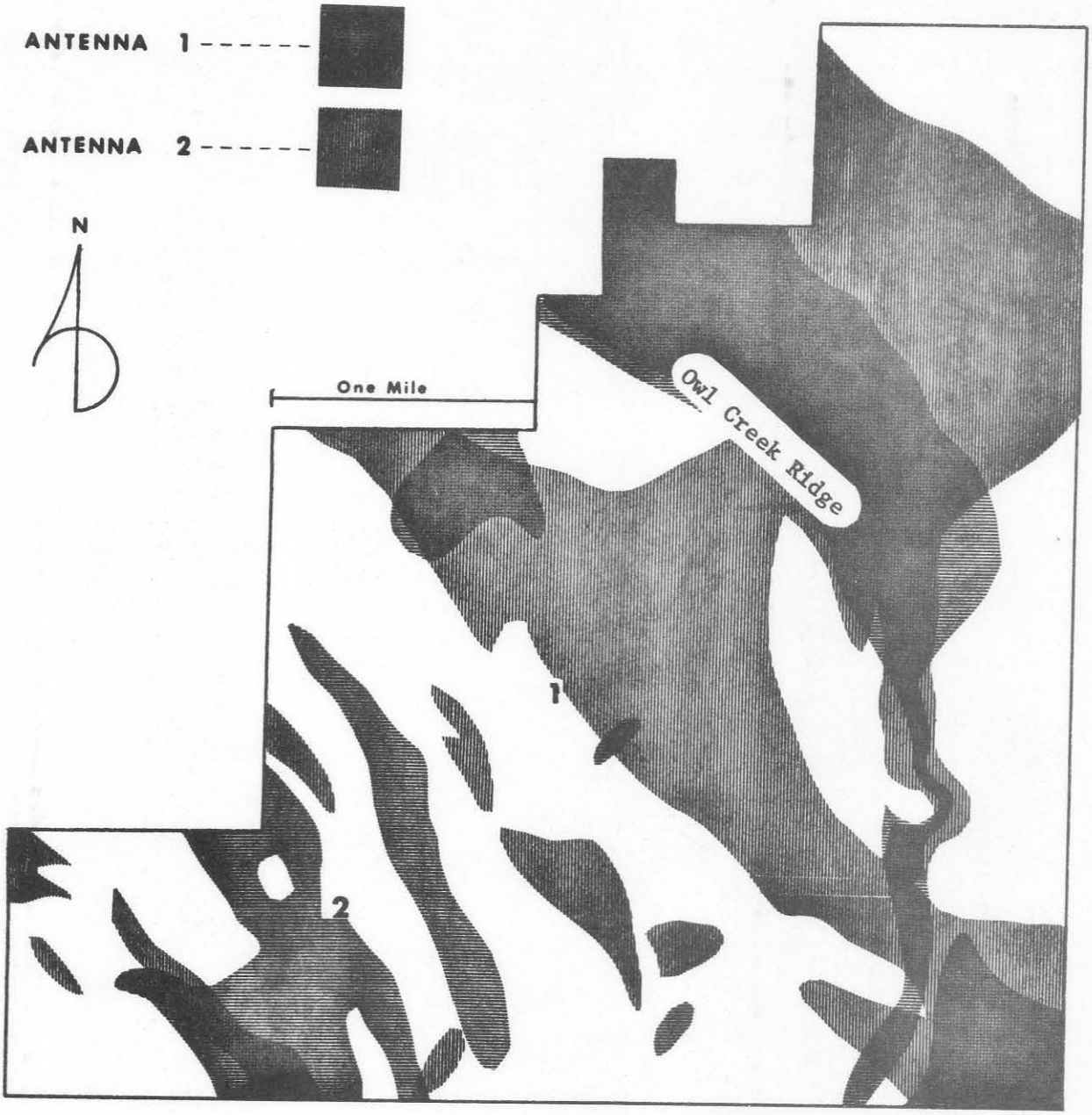

Fig. 5. Areas within the study area that are out of line-of-sight from permanent receiving antennas.

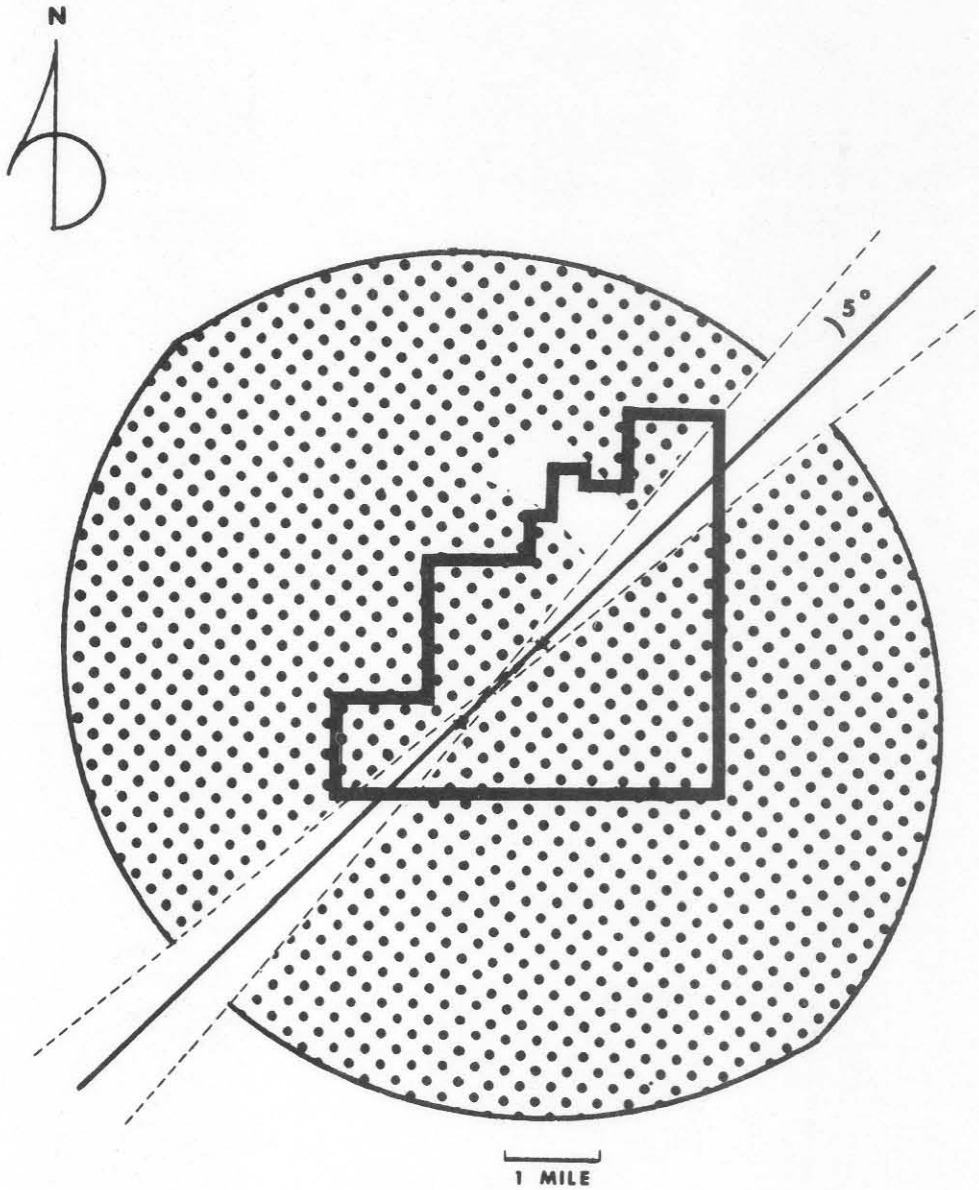

Fig. 6. Area in which telemetry locations are acceptable.

Spotlight counts are being conducted at least once each month to tally distribution and ratio of the two species. The counts also provide a good opportunity for observation of color marked hares for movement information. The study area was divided into 43 quarter sections, and the tally for each quarter section was designated as one of the following five, arbitrary categories: (i) white-tail (100%) only; (ii) white-tail (75-99%), occasional black-tail (1-25%); (iii) white-tail (26-74%) and black-tail (26-74%); (iv) black-tail (75-99%), occasional white-tail (1-25%); and (v) black-tail (100%) only.

Aerial flights are made over the study area after ground-covering snow storms to map relative track density of hares. Mapping is accomplished from a slow flying aircraft making north-south passes (0.5 mile apart) over the study area at altitudes of 50-100 ft.

RESULTS

Since the study was initiated (February 1, 1970), 136 hares have been tagged. The black-tail:white-tail ratio was 100:30. The female:male ratio was 100:94. Trap success was highest during the colder months (Fig. 7). Trap response of hares varied among individuals. For example, hare number 18 was captured 13 times. Some other hares living in the vicinity of traps (several flushed within 20 ft of traps) were not captured even after special sets and baits were provided.

Recapture data indicate ovate occupation areas of approximately 640 acres. Only the period from March 28 to May 8, 1970 provided sufficient recapture data for use in plotting occupation areas. Fig. 8 shows occupation areas for hares 18 and 23 using 13 and 9 recaptures, respectively.

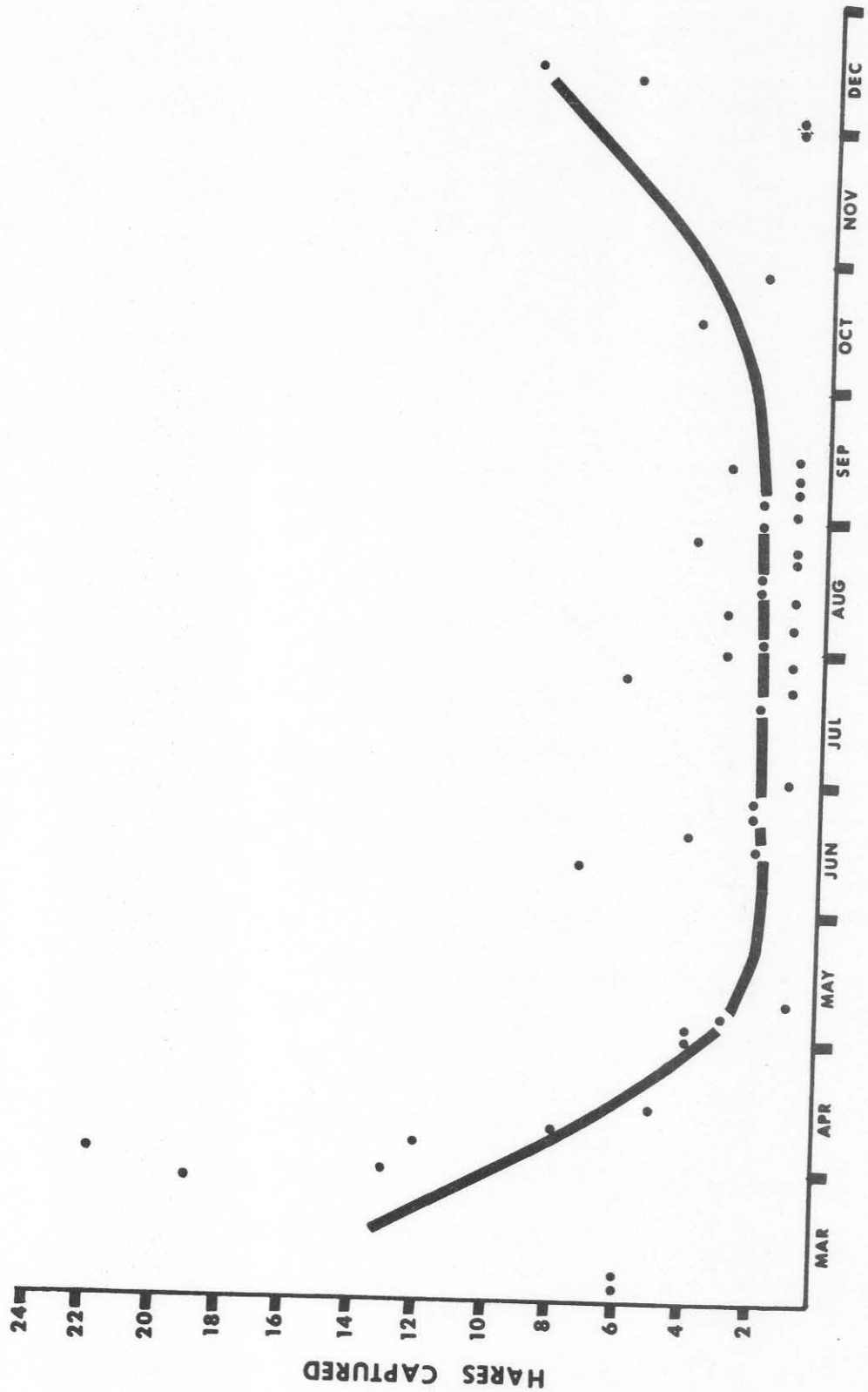

Fig. 7. Suggested trend of trap success.

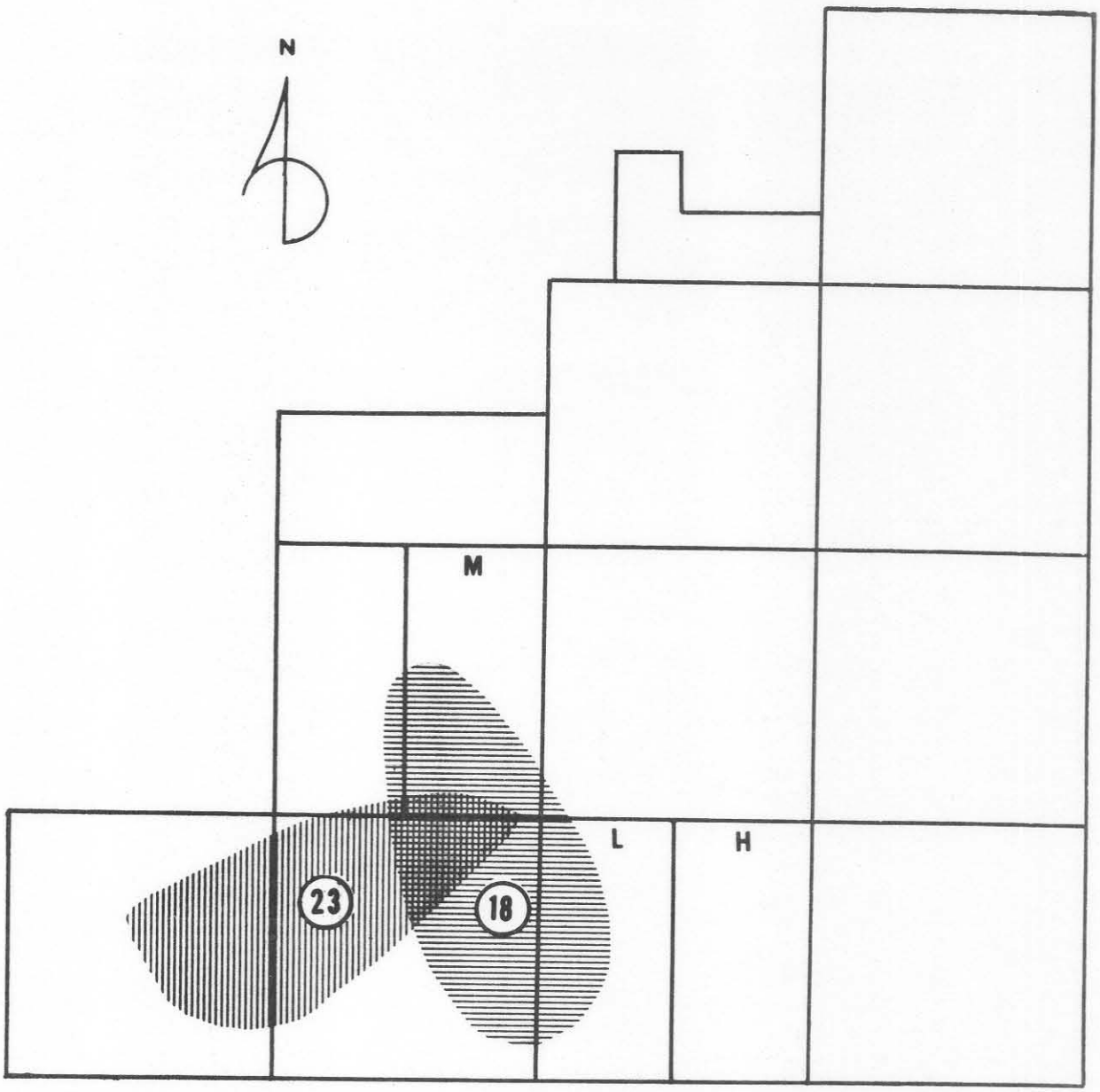

Fig. 8. Occupation areas of two hares as determined by retrapping.

Population density indices were not obtainable from multiple-recapture tag-ratio methods because of low recapture success and unequal catchability of individual hares. Jolly's (1965) stochastic method and Jackson's method (Andrewartha 1961) were attempted.

Absolute-density counts were made twice during the year when student help was available to man the drive counts. Approximately 30 participants conducted a spring (April 25) and a fall (November 14) count (Table 1). Black-tail:white-tail ratios of 100:38 and 100:24 were observed during the spring and fall counts, respectively. Dead hares were tallied on the plots; nine were observed in the spring and one in the fall.

Of 28 hares instrumented with temperature-sensitive radio transmitters, six (21%) remained acitve, 14 (50%) were lost from radio contact, and eight (29%) died from various causes. Stoddard (1970) suggests that disappearance may occur due to movement beyond receiving range, transmitter failure, or removal of the transmitter by an outside influence such as predators or hunters.

Of the eight hares found dead, two died after getting the transmitter collar lodged in their mouths. Death was probably due to starvation. There was no evidence of scavenging. Transmitter collar design was changed and has prevented reoccurrence of this accident. One hare was shot by a hunter. The other five (62%) apparently were killed by predators. Predation was determined from evidence at the scene using criteria outlined by Stoddard (1970). Three hares were apparently consumed by coyotes. One transmitter was located by signal and recovered from a coyote den. Another was found approximately 40 yards from the den. One hare was apparently taken by an avian predator and another by a bobcat.

Table 1. Jackrabbit census counts on four .25-section plots, 1970.

Plot No.	April	November	Percent Change
1	23	63	+174
2	5	11	+120
3	0	10	---
4	5	9	+ 80
TOTAL	33	93	+185

Remote locations by radio telemetry indicate occupation areas of approximately 640 acres per hare. Fig. 9 shows occupation areas of two hares, number 18 and 67, as determined by telemetry for 81 days (June 25-Sept. 14) and 35 days (Aug. 10-Sept. 14) respectively, and for 14 and 13 locations, respectively. Hourly movements of six instrumented hares were monitored for two consecutive nights. The first tracking period began at 6:00 AM, December 16, and locations were determined hourly until 7:00 AM, December 17. Skies were clear and ambient air temperatures ranged from 34 to 22°F. The second tracking period began at 7:00 AM, December 18. Skies were cloudy, and approximately 2 inches of snow fell from 11:30 PM until 7:00 AM. Ambient air temperatures ranged from 18 to 21°F. There did not appear to be any significant difference in the distances moved or area covered by the hares during the two periods (Table 2).

Use of 0.5 section pastures grazed by cattle at light, moderate, and heavy intensities by the six instrumented hares was also investigated (Fig. 10 and 11). During the two tracking periods, individual hares were located 23 times within these pastures. The distribution of locations was as follows: 12-lightly grazed, 0-moderately grazed and 11-heavily grazed.

Forty hares were initially trapped in the three pastures. The distribution of capture locations were: 8-lightly grazed, 16-moderately grazed, and 16-heavily grazed.

Species distribution was complemented by data from six spotlight counts (Fig. 12). The counts were conducted once each month from July through December and yielded a low tally of 16 and high of 54 hares per count night. The black-tail:white-tail ratio was 100:15.

Track density maps were constructed in March and November (Fig. 13 and 14).

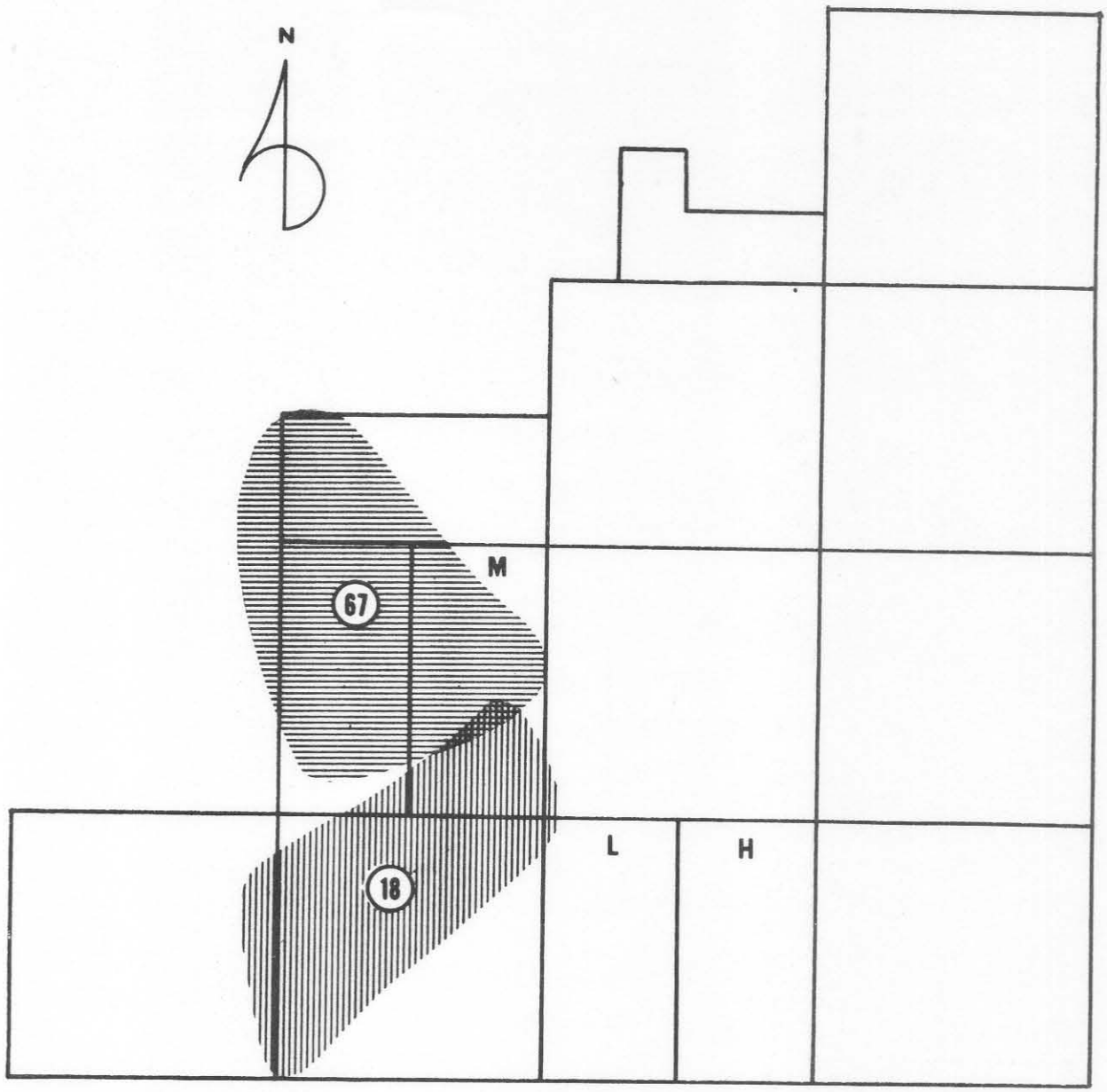

Fig. 9. Occupation areas of two hares as determined by telemetry.

Table 2. Movements of six hares on a clear and a stormy night.

		Hourly Dist. (Miles)	Total Dist. (Miles)	Area (Sq Miles)
Dec. 16-17 (clear)	Range	.20-1.08	1.50-9.75	.11-1.06
	Average	.45	4.08	.42
Dec. 17-18 (stormy)	Range	.14-.88	1.00-8.75	.06-1.22
	Average	.46	4.83	.49

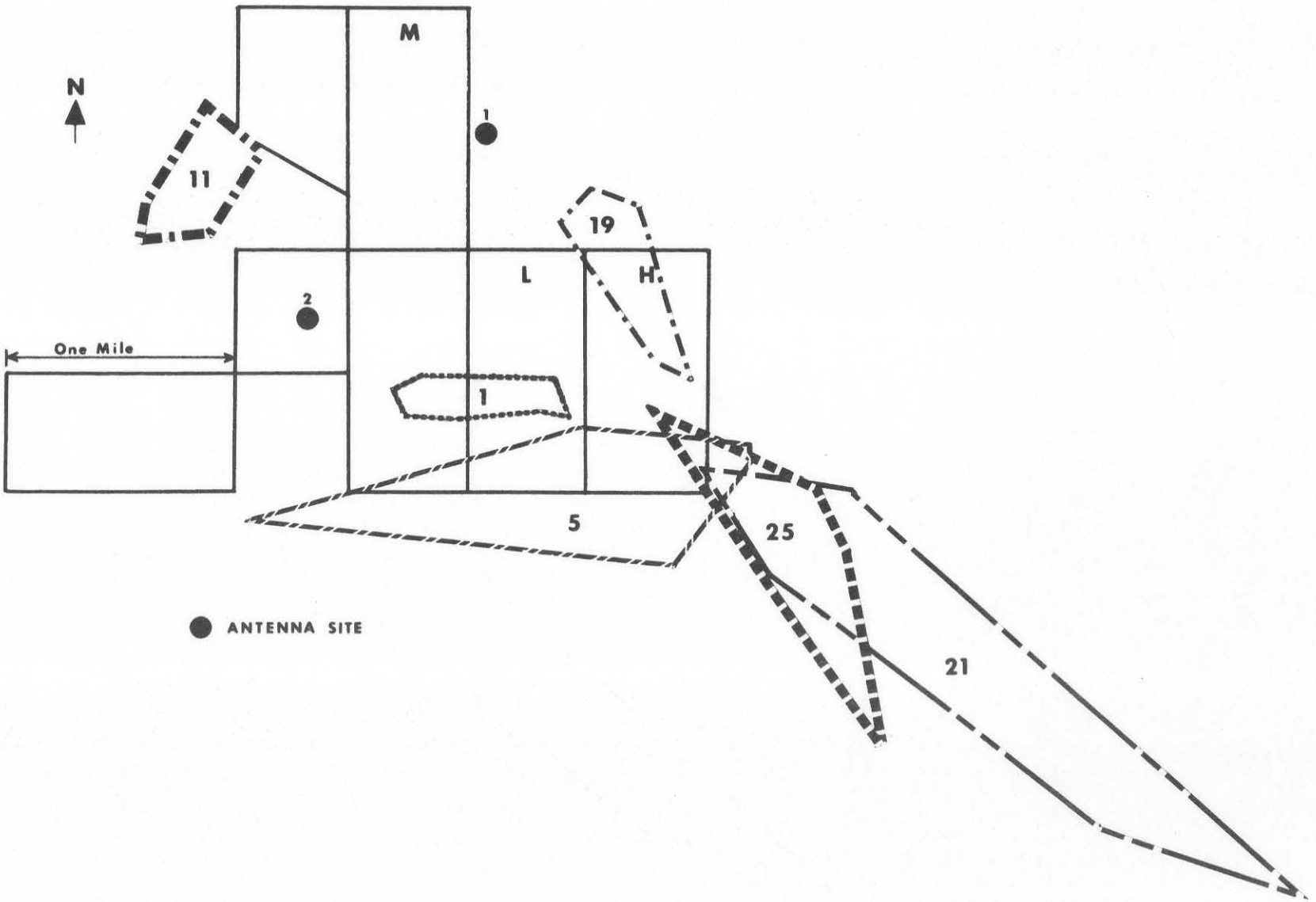

Fig. 10. Areas of occupation of six jackrabbits on a clear night in relation to light, medium and heavily grazed pastures.

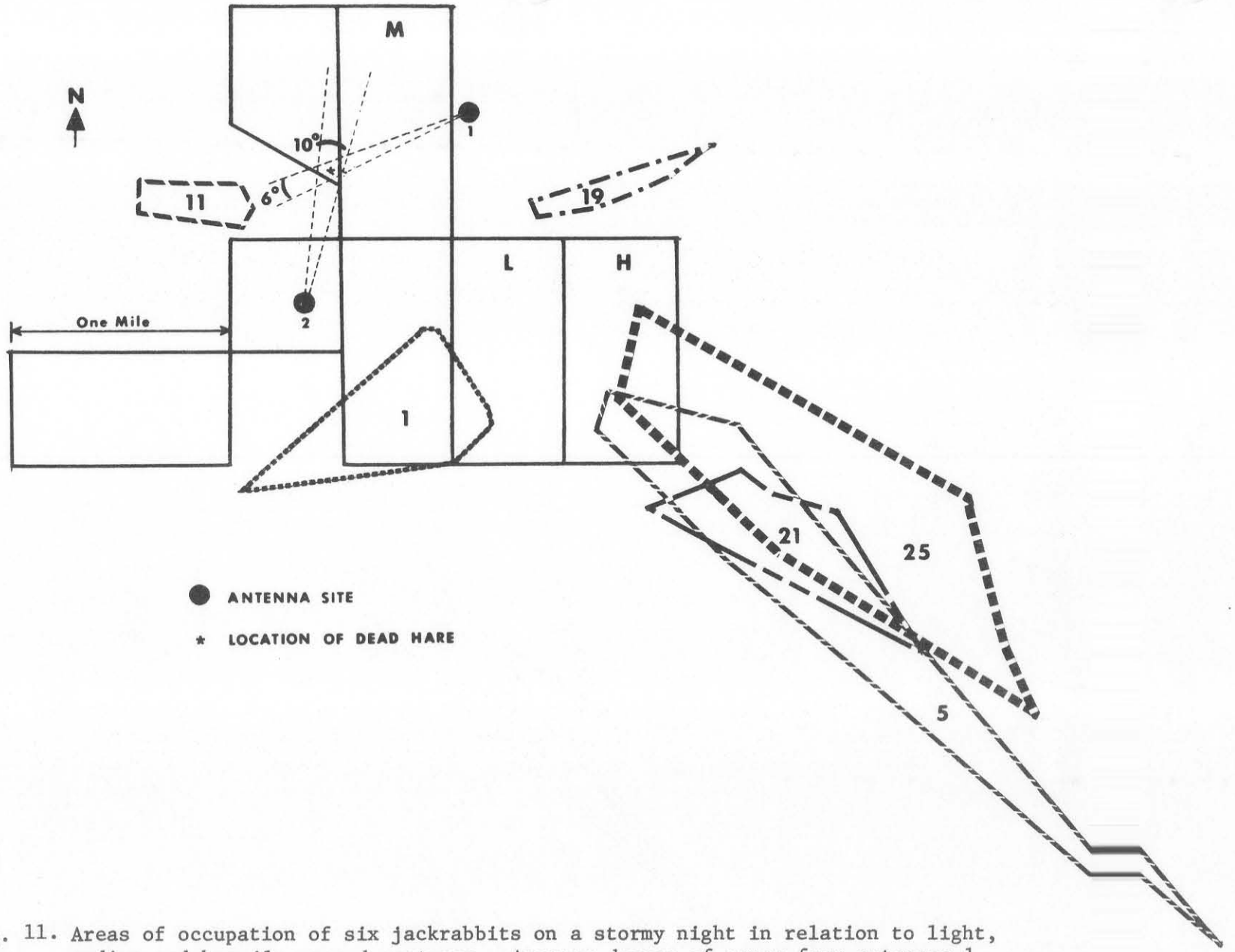

Fig. 11. Areas of occupation of six jackrabbits on a stormy night in relation to light, medium and heavily grazed pastures. Average degree of error from antennae 1 and 2.

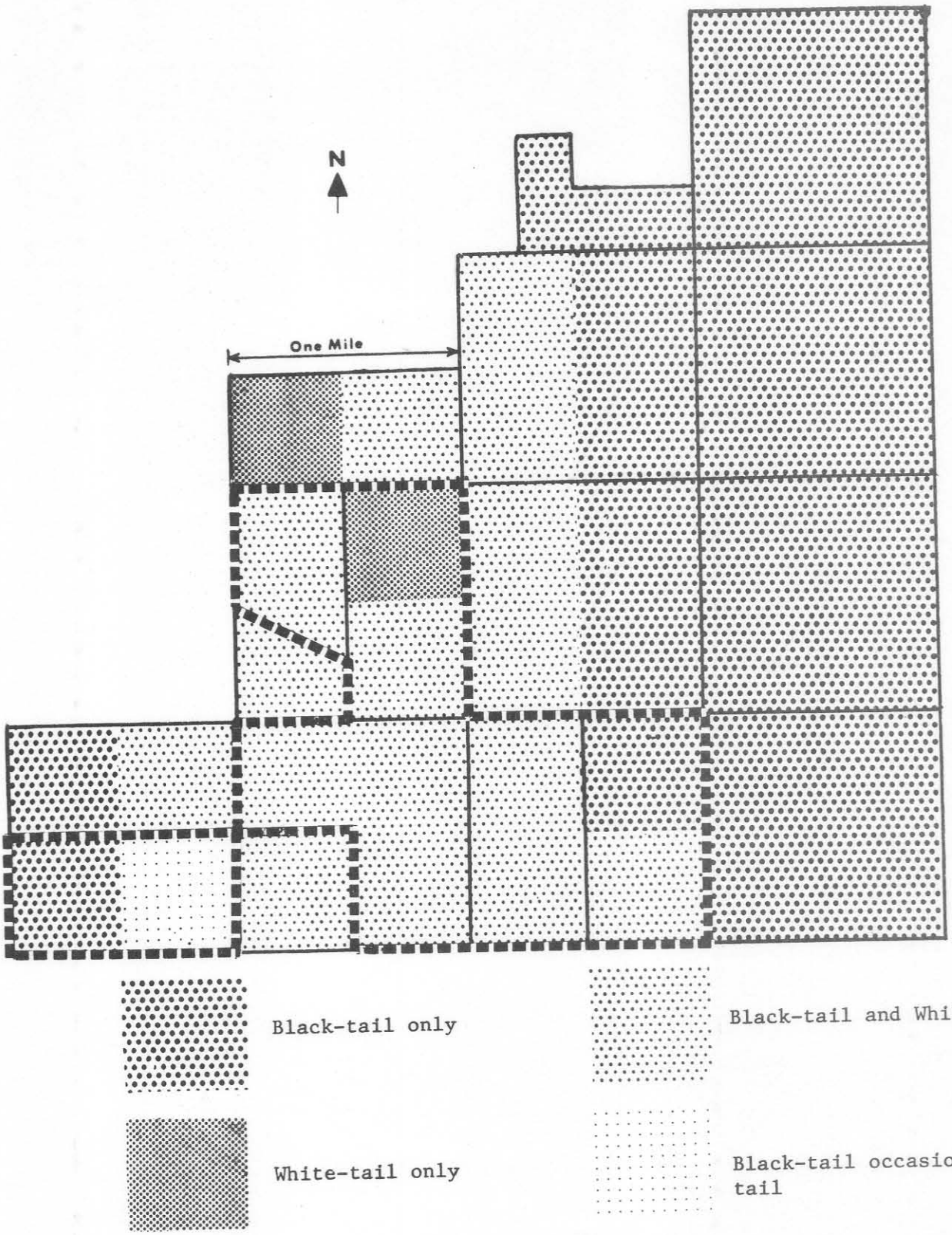

Fig. 12. Jackrabbit species distribution on study area and intensive site as determined by spotlight counts.

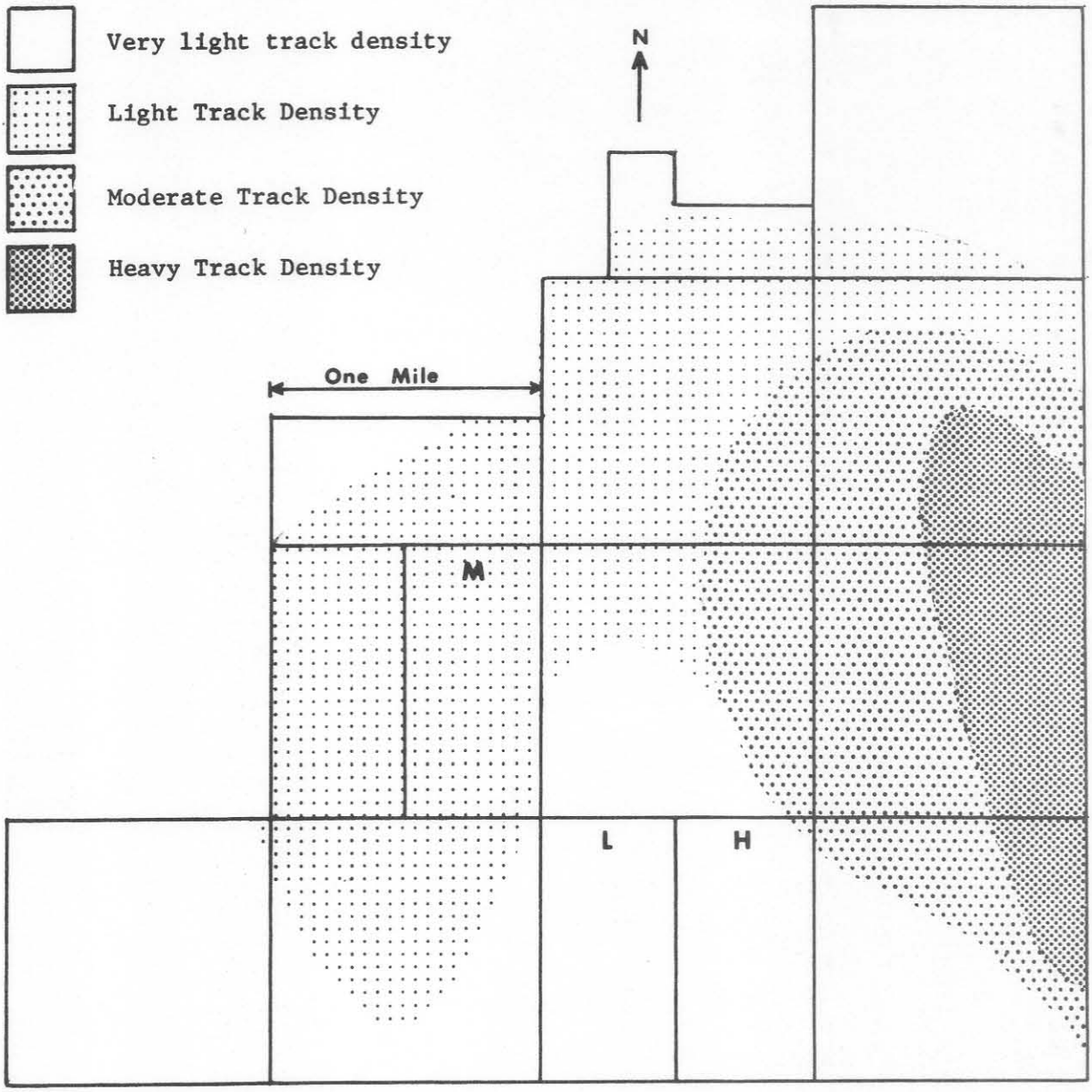

Fig. 13. Jackrabbit track density in relation to light, medium and heavily grazed pastures, April, 1970.

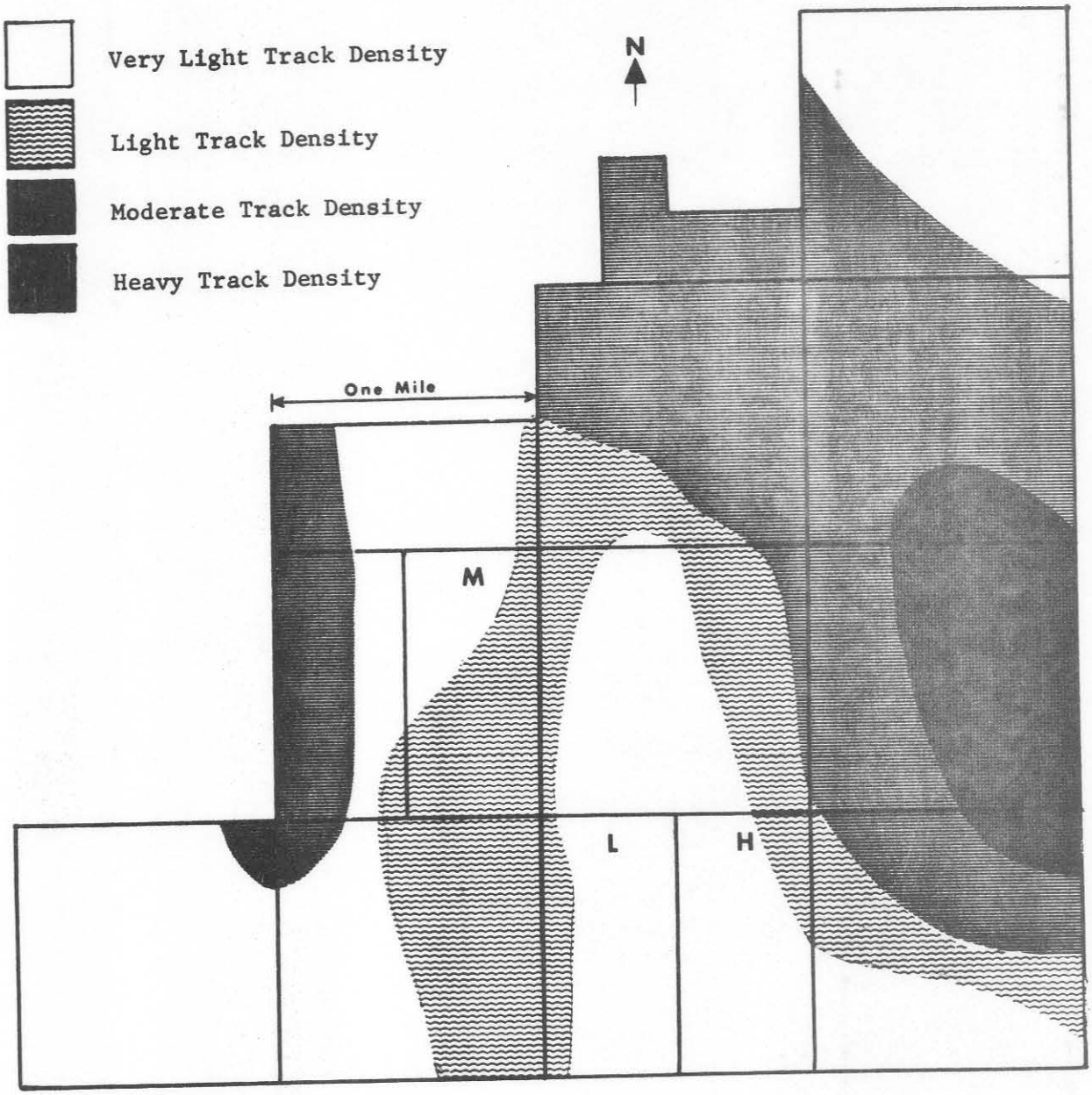

Fig. 14. Jackrabbit track density in relation to light, medium and heavily grazed pastures, November, 1970.

DISCUSSION

The spring decline of trap success was probably due to vegetative growth and initiation of the micro-grid pattern (which removed traps from some high-rabbit-density areas). The fall increase in success was probably due to increased population size (natality) and drying of the vegetation which made the bait more attractive.

Species ratios obtained from trapping and drive plots indicate a 3:1 black-tail:white-tail ratio. White-tailed jackrabbits may occasionally be mistaken for black-tails in night observations.

Trap-retrap and radio telemetry data indicate seasonal occupation areas (home ranges) of approximately 640 acres for individuals of both species. Vorhies and Taylor (1933) reported home ranges for black-tailed jackrabbits of 1-2 miles. In California, Lechleitner (1958) found black-tail home ranges to be less than 50 acres, while Orr (1940) reported ranges up to 1 mile. Black-tailed jackrabbits in southern Idaho had home ranges of less than 40 acres (French et al. 1965). Differing definitions of "home range" and the various methods of estimating size makes comparison of occupation areas of little value. Lechleitner (1958) and Sanderson (1966) realized that home range size is a function of extrinsic influences rather than a species trait.

Sightings of marked hares have not indicated movements of over 1 mile. There have been no indications from observations or recaptures that the hares concentrate or disperse to form new occupation areas either on a seasonal or annual basis.

Daily movements may concentrate hares into certain areas such as fields when feeding, or into areas of cover during inclement weather. Concentrations of hares are often seen in the .25-section fields near the study area. Present

data indicates that these hares are not out of their normal home range. It is possible, at an average annual density of 63 hares per square mile, to have over 1000 hares in a .25-section field at the same time without any of the hares leaving their 640-acre home range.

The pre-littering season count of .05 hares per acre and the post-littering season count of .14 hares per acre should represent the low and high population densities for the year 1970. A pre-littering season count in 1971 will allow for calculation of winter mortality. Present data indicates a fluctuation of 185% in the population in one calendar year. The average density for the year was .09 hares per acre. This density appears to be below most of the densities reported in the literature: .002/acre (Biswell et al. 1952), .08/acre (Hayden 1966), .22/acre (Vorhies and Taylor 1933, Fautin 1946), .27-.75/acre (Wooster 1935), .38/acre (Woodbury 1955), .5/acre (French et al. 1965), 1.0/acre (Lechleitner 1958), and 14/acre (Bronson and Tiemeier 1959).

The telemetry technique of locating mortality will serve to complement population studies. It can supply information on timing and causes of loss that are unknowns in population estimates (Stoddard 1970).

There appears to be no correlation between number of hare locations with the intensity of grazed pastures, as determined by telemetry and trapping. Sample sizes are presently too small for statistical analysis.

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APPENDIX I

FIELD DATA

Telemetry Data

The Jackrabbit telemetry data collected at the Pawnee Site in 1970-71 is Grassland Biome data set A2U104B. The data consists of three types of cards: (i) initial trap card, (ii) mortality card if rabbit has died, and (iii) telemetry card(s). A description and listing of the data follow.

Column	Contents
i. Initial trap card	
1	Card type code
2-4	Rabbit number
6-7	Year
8-10	Day of year
12-15	Time
17-19	Right ear tag number
21-23	Left ear tag number
25	Right tag color code
27	Left tag color code
29-30	Color number
32-34	Radio number
36-37	Channel number
39	Species code
41	Age code
43	Sex code
45-47	X coordinate
49-50	Y coordinate

52	Reproductive status code
54	Mortality Code

ii. Mortality card

1	Card type code
2-4	Rabbit number
6-7	Year
8-10	Day of year
12-15	Time
17	Reproductive status code
19	Cause of death code
21	Condition of victim code
23-25	X coordinate
27-28	Y coordinate

iii. Telemetry card

1	Card type code
2-4	Rabbit number
6-7	Year
8-10	Day of year
12-15	Time
17-18	Channel number
19	Channel changed rabbits code
21-23	Bearing #1
25-27	Bearing #2
29-31	Ambient temperature
33-35	Beeps per minute (BPM)

Codes Used In Data

Card Type Code

I - Initial trap card

M - Mortality card

T - Telemetry card

Species

1 - BT - Jack

2 - WT- Jack

3 - Cottontail

Age Code

1 - Juvenile

2 - Adult

Reproductive Status Code

0 - None

1 - Pea

2 - Grape

3 - Walnut

4 - Egg

5 - Term

6 - Unknown

7 - Scrotal testicles

Mortality Code

1 - Living

2 - Dead

Channel Changed Rabbits Code

0 - Not changed

1 - Changed rabbits once

2 - Changed rabbits twice

3 - Etc.

Color Code

1 - Red

2 - Green

3 - Orange

4 - White

5 - Yellow

Sex Code

1 - Male

2 - Female

3 - Unknown

Cause of Death Code

1 - Mammal predator

2 - Avian predator

3 - Disease

4 - Accident

5 - Weather

6 - Unknown

7 - Other

8 - Shot

9 - Shock

0 - Trap

Condition of Victim Code

1 - Fresh kill

2 - Remains

*** DATA ***

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S051 70236 2010 101 090          052
S051 70237 1520 101 085      094 068
S051 70238 1445 101 090      086 060
S051 70246 1245 101 090      080 060
S051 70251 1405 101 090      085 060
S051 70254 1040 101 089      078 064
S051 70257 1415 101 085      048 064
I052 70180 1535 165 000 0 0 00 001 05 2 1 1 117 32 6 2
M052 70257 1200 6 1 2 115 30
S052 70222       051          032
S052 70225 1545 051      014 094 032
S052 70226       051      018 070 032
S052 70229 1330 051      030 090 032
S052 70230 1310 051      010 090 032
 52 70232 1330 051      028 071 032
S052 70236 1535 051      030 085 032
S052 70237 1445 051      036 095 032
S052 70238 1445 051      035 086 032
S052 70244 1230 051      000     032
S052 70245 1055 051      040 082 032
S052 70246 1240 051      028 081 032
S052 70247 1400 051      020 082 032
S052 70251 1430 051      031 087 032
S052 70254 1030 051      030 078 032
S052 70257 1    052          048 028
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M053 70216 0000 6 2 2 139 08
S053 70222 1612 041      118 088 084
S053 70236 1430 041 140      087 080
S053 70257 1430 041 145 125 048 076
S053 70268 1830  4  175 126  36  60
S053 70280 1955  4  150 116  14  72
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M055 70236 0000 6 8 1 101 42
S055 70245 1050 151 070      082 064
S055 70246 1242 151 077      080 064
S055 70251 1420 151 080      086 064
S055 70254 1040 151 076      078 064
I056 70203 1450 254 000 0 0 00 001 17 1 2 2 105 40 6 1
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S056 70222 1550 182 245 235 088 092
I059 70204 1340 191 000 0 0 00 001 22 1 2 1 100 40 6 1
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S059 70236 1615 221 240     086 068
S059 70236 1830 221 225     070 064
S059 70237 1520 221 225 215 094 078
S059 70254 1045 221 229 225 078 080
S059 70257 1415 221     220 048 068
I060 70204 1400 106 188 1 4 01         1 2 2 120 33 1 1
S060 70049 1730 24  209 109  30   9
S060 70049 1830 24  209 127  28   8
S060 70049 1920 24  202 131  28   8
S 60 70049 2120 24  212 104  30   8
S060 70049 2020 24  214  76  28   8
S 60 70049 2220 24  207  99  32   8
S 60 70050 2420 24  211  87  30   8
S 60 70049 2320 24  213  95  31   8
S 60 70050 0120 24  212 117  29
S 60 70050 0220 24  212 109  28   8
S 60 70050 0320 24  204 106  27   8
S 60 70050 0430 24  203 103  26
S 60 70050 0530 24  212 107  25   8
S 60 70050 0625 24  209 105  25   8
S060 70050 0720 24  212 102  24   8
S 60 70050 0750 24  211 107  26
S060 70050 0825 24  194 110  28
I062 70209 1025 272 000 0 0 00 001 03 2 1 3 120 37 6 1
S062 70222 1608 031         088 066
S062 70225 1540 031         094 052
S062 70229 1400 031 018     094 060
S062 70230 1315 031 013     090 060
S062 70232 1330 031 020     071 076
S062 70236 2025 031 300
S062 70237 1445 031 000         095
S062 70237 1445 031 000     095 084
S062 70238 1440 031 355     087 076
S062 70244 1310 031 015     091 092
S062 70245 1050 031 005     082 088
S062 70246 1230 031 355     082 088
S062 70247 1520 031 001     082 080
S062 70251 1400 031 000     085 084
S062 70253 1235 031 354     070 080
I067 70218 1520 129 000 0 0 00 002 18 2 2 2 115 23 2 1
S067 70222 1545 182 300 345 088 060
S067 70225 1620 182 250 340 096 064
S067 70226 1645 182 320 358 070 056
S067 70229 1315 182 320 003 094 064
S067 70230 1310 182 215 330 090 050
S067 70232 1330 182 315 000 071 060
S067 70236 1510 182 290 000 086 064
S067 70237 1445 182 295 356 095 064
S067 70238 1445 182     000 086 064
S067 70244 1230 182 315 355 091 068
S067 70245 1055 182 315 360 082 064
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S067 70251 1425 182 285 036 087 068
S067 70253 1245 182 276     070 072
S067 70254 1040 182 294 000 078 064
S067 70257 1415 182 265 355 048 060
S067 70258 1400 18  308   7  66  60
S067 70268 1840 18  285   8  34  60
S067 70280 2030 18  282   6  14  42
S067 70289 2050 18  160  76  28  52
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S072 70222 1520 241 180 088 088 048
S072 70229 1330 241 115     090 048
I076 70231 1430 107 000 0 0 00 002 16 2 2 2 111 15 3 1
S076 70232 1600 162 315 353 074 044
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S084 70351 2230 15  65      20  32
S084 70351 2328 15  68      20  32
S084 70352 0035 15  68      22  32
S084 70352 0122 15  68      21  32
S084 70352 0215 15  65      18  32
S084 70352 0310 15  65      19  28
S084 70352 0400 15  68      20  32
S084 70352 0525 15  68      21  32
S084 70352 0600 15  68      20  32
S084 70352 0700 15  65      20  32
I091 70277 1550 135                     1 2 2 115 20 2 1 R
S091 70280 2010  5    5  21  14  20
S091 70286 2000  5  357  41  33  24
S091 70296 1830  5  348  66  42  20
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S107 70049 2000  5  167 100  28  56
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S107 70049 2200  5  174 110  32  52
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S107 70050 2400  5  179 107  31  52
S107 70050 0100  5  182 122  29
S107 70050 0200  5  179 118  28  56
S107 70050 0300  5  189 123  27  52
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S107 70050 0600  5  199 125  25  56
S107 70050 0700  5  192 114  24  54
S107 70050 0760  5  174 112  26
S107 70050 0800  5  174 121  28
S110 70350 1830  1  190 120  32  72
S110 70350 2000  1           28  72
S110 70350 2100  1      110  28  72
S110 70350 2200  1  187 108  26  72
S110 70350 2300  1  177 110  26  72
S110 70350 2400  1  177 108  26  72
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S110 70351 0600  1  197 126  24  72
S110 70351 0700  1  167 106  22  72
S110 70351 1925 01  190  95  22  48
S110 70351 2120 01  183 133  18  76
S110 70351 2205 01  175 118  20  68
S110 70351 2335 01  180 105  20  28
S110 70352 0010 01  178 115  22  44
S110 70352 0120 01  185 115  21  66
S110 70352 0245 01  175 115  18  72
S110 70352 0315 01  185 120  19
S110 70352 0420 01  190 108  20  52
S110 70352 0505 01  188 120  21
S110 70352 0635 01  195 115  20  84
S110 70352 0705 01  195  95  20 100
I113 70335 1410 410      1 1  1   1 23 1      115 15 6 1
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S113 70350 2000 23       13  28  43
S113 70350 2100 23  257  16  28  43
S113 70350 2200 23  260  11  26  43
S113 70350 2300 23  260  11  26  43
S113 70350 2400 23  260  13  26  43
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 113 70351 0200 23  260  13  26  43
 113 70351 0300 23  260  13  26  43
S113 70351 0400 23  260  13  24  43
S113 70351 0500 23  257  18  24  43
S113 70351 0600 23  260  08  24  43
S113 70351 0700 23  260  06  22  43
I119 70349 1113 409                 001 25 2 2 1 100 30 6 1
S119 70350 1915 25  146 101  32  28
S119 70350 2000 25      106  28  28
S119 70350 2100 25  137 108  28  28
S119 70350 2200 25  137 105  26  28
S119 70350 2300 25  140 106  26  28
S119 70350 2400 25  135 106  26  28
S119 70351 0100 25  142 110  26  28
S119 70351 0200 25              26  28
S119 70351 0300 25  137 111  26  28
S119 70351 0400 25  140 113  24  28
S119 70351 0500 25  142 111  24  28
S119 70351 0600 25  145 124  24  28
S119 70351 0700 25  150      22  28
S119 70351 2020 25  150 105  20  36
S119 70351 2130 25  143 116  18  28
S119 70351 2228 25  133  88  20  32
S119 70351 2330 25  130 106  20  32
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S119 70352 0155 25  135 113  21  36
 19 70352 0240 25  135 118  18  32
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I120 70349   1315     430      002 11 1 1 2 120 15 6 1
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S120 70351 0400 11  280 336  24  44
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S120 70351 0600 11  257 301  24  44
S120 70351 0700 11  255 318  22  44
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S120 70352 0630 11  260 338  20  44
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S120 70049 1905 11  294      28  24
S120 70049 2005 11  297      28  22
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S120 70049 2205 11  290      32  24
S120 70049 2305 11  300      31  24
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S120 70050 0205 11  299      28  22
S120 70050 0305 11  297      27
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S120 70050 0710 11  294 358  24  33
S120 70050 0810 11  294 350  28
I121 70349      432          003 05 2 2 2 105 23 6 1
S121 70350 1830  5  137 103  32 140
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S121 70350 2300  5  162 118  26 140
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S121 70351 0200  5  162 108  26 140
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 121 70351 0300  5  162 116  26 140
S121 70351 0400  5  162 118  24 140
S121 70351 0500  5  139 105  24 140
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S121 70351 0700  5  117      22 140
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S121 70351 2055 05  155 110  19  56
S121 70351 2215 05  138 104  20  48
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S121 70352 0015 05  138 125  22  48
S121 70352 0128 05  145 120  21  48
S121 70352 0220 05  148 110  18  52
S121 70352 0320 05  148 118  19  48
S121 70352 0405 05  150 103  20  52
S121 70352 0515 05  143 110  21  52
S121 70352 0605 05  135 103  20  52
S121 70352 0705 05  115      20  60
I122 70349 1125 369                 001 21 2 2 1 103 30 6 1
S122 70350 1904 21  137 111  34  36
S122 70350 2000 21  140 111  28  36
S122 70350 2100 21  137 111  28  36
S122 70350 2200 21  145 108  26  36
S122 70350 2300 21  142 111  26  36
S122 70350 2400 21  132 105  26  36
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 122 70351 0200 21  140 113  26  36
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S122 70351 0400 21  145 116  24  36
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S122 70351 0700 21  135          36
S122 70351 2008 21  145 118  20  36
S122 70351 2120 21  153 118  18  36
S122 70351 2225 21  138 118  20  36
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S122 70352 0030 21  140 109  22  36
S122 70352 0145 21  138 110  21  36
S122 70352 0235 21  138 114  18  36
S122 70352 0330 21  143 116  19  36
S122 70352 0412 21  140 118  20  36
S122 70352 0520 21  143 118  21  36
S122 70352 0620 21  135 110  20  36
S122 70352 0710 21  138 110  20  40
I123 70349      416                 002 19 2 2 2 107 23 6 1
S123 70350 1855 19  107  68      56
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S123 70350 2100 19  112  66  28  56
S123 70350 2200 19  115  66  26  56
S123 70350 2300 19  107  68  26  56
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 123 70351 0200 19  107  63  26  56
S123 70351 0300 19  107      26  56
S123 70351 0400 19  132  66  24  56
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S123 70351 0700 19  140  94      56
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S123 70351 2115 19  135  68  18  56
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S123 70352 0230 19  118  70  18  56
S123 70352 0325 19  100  65  19  56
S123 70352 0410 19  103  66  20  56
S123 70352 0520 19   90  68  21  52
S123 70352 0615 19  100  70  20  60
S123 70352 0707 19  100      20  64
I142 71036 1630 373                  2 17 2 2 2 100 20 6 1
S142 70049 1730 17  186 129  30  20
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S142 70049 1915 17  194 143  28  16
S142 70049 2115 17  195 147  30  12
S142 70049 2215 17  195 134  32  12
S142 70049 2315 17  193 142  31  16
S142 70050   15 17  193 136  30  16
S142 70050 0115 17  192 141  29
S142 70050 0215 17  192 147  28  16
S142 70050 0425 17  199 124  26
S142 70050 0525 17  182 124  25  13
S142 70050 0620 17  194 131  25  13
S142 70050 0710 17  189 132  24  12
S142 70050 0745 17  192 128  26
S142 70050 0820 17  190 126  28
I143 71036 1630 382                  3 16 2 2 2 103 22 6 1
S143 70049 1730 16  189  97  30  20
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S143 70049 2010 16  184 104  28  20
S143 70049 2110 16  196 120  30  20
S143 70049 2210 16  193 131  32  20
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S143 70050   10 16  192  96  30  20
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S143 70050 0210 16  182 131  28  20
S143 70050 0310 16  194 129  27  19
S142 70050 0315 17  192 148  27  12
S143 70050 0420 16  199 108  26
S143 70050 0520 16  197 107  25  16
S143 70050 0615 16  202 118  25  16
S143 70050 0700 16  189 109  24  16
S143 70050 0740 16  177 118  26
S143 70050 0815 16  189 116  28
```

52	Reproductive status code
54	Mortality code

ii. Mortality card

1	Card type code
2-4	Rabbit number
6-7	Year
8-10	Day of year
12-15	Time
17	Reproductive status code
19	Cause of death code
21	Condition of victim code
23-25	X coordinate
27-28	Y coordinate

iii. Retrap card

1	Card type code
2-4	Rabbit number
6-7	Year
8-10	Day of year
12-15	Time
17	Capture type code
19-21	New tag number
23-25	X coordinate
27-28	Y coordinate
30	Instrument replace code
32	Reproductive status code

Retrap Data

The Jackrabbit and Cottontail retrap data collected at the Pawnee Site in 1970-71 is Grassland Biome data set A2U103B. The data consists of three types of cards: (i) initial trap card for each rabbit, (ii) mortality card if rabbit has died, and (iii) retrap card(s). A description and listing of the data follow.

Column	Contents
i. Initial trap card	
1	Card type code
2-4	Rabbit number
6-7	Year
8-10	Day of year
12-15	Time
17-19	Right ear tag number
21-23	Left ear tag number
25	Right tag color code
27	Left tag color code
29-30	Color number
32-34	Radio number
36-37	Channel number
39	Species code
41	Age code
43	Sex code
45-47	X coordinate
49-50	Y coordinate

Codes Used In Data

Card Type Code

I - Initial trap card

M - Mortality card

R - Retrap card

Species Code

1 - BT - Jack

2 - WT - Jack

3 - Cottontail

Age Code

1 - Juvenile

2 - Adult

Reproductive Status Code

0 - None

1 - Pea

2 - Grape

3 - Walnut

4 - Egg

5 - Term

6 - Unknown

7 - Scrotal testicles

Mortality Code

1 - Living

2 - Dead

Capture Type Code

1 - Sighting

2 - Retrap

Color Code

1 - Red

2 - Green

3 - Orange

4 - White

5 - Yellow

Sex Code

1 - Male

2 - Female

3 - Unknown

Cause of Death Code

1 - Mammal predator

2 - Avian predator

3 - Disease

4 - Accident

5 - Weather

6 - Unknown

7 - Other

8 - Shot

9 - Shock

0 - Trap

Condition of Victim Code

1 - Fresh kill

2 - Remains

Instrument Replace Code

0 - Not replaced

1 - Replaced battery

2 - Replaced transmitter

*** DATA ***

```
        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890

I001 70059 0920 209 214 3 2 01                  1 2 1 111 20 6 1
I002 70060 1045 224 225 3 2 02                  2 2 1 114 19 6 1
I003 70060 1105 219 208 3 2 03                  2 2 1 113 18 6 1
I004 70060 1145 215 218 2 1 04                  1 2 1 142 06 6 1
I005 70061 1625 205 217 2 1 05                  1 2 2 141 09 6 1
I006 70061 1800 210 216 2 2 06                  1 2 2 144 30 6 1
I007 70063 1130 194 177 3 2 07 001 06 2 2 2 114 19 6 1
R007 70088      2     113 20    2
R007 70093      2     113 20
R007 70094      2     111 20
R007 70095      2     111 20
R007 70096      2     111 20
R007 70097      2     113 20
R007 70099      2     111 20
R007 70106      2     115 20
R007 70167      2     115 20
I008 70064 1600 156 178 4 4 08                  1 2 1 156 14 6 1
I009 70064 1625 187 200 4 4 09                  1 2 2 148 15 6 1
I010 70064 1700 195 181 4 3 02                  1 2 2 148 30 1 1
I011 70064 1712 196 999 2 2 03                  1 2 1 144 30 6 1
I012 70065 1500 999 999 4 3 01                  1 2 1 148 30 6 1
I013 70087 1345 042 022 3 1 01                  1 2 1 113 20 6 2
M013 70091 0000 6 1 1 125 18
R013 70089      2     115 26
R013 70091      2     125 18
I014 70087 1415 068 066 4 1 01                  1 2 1 125 17 6 1
I015 70087 1500 063 040 5 1 01                  1 2 1 137 26 2 1
I016 70087 1745 038 089 5 1 02                  1 2 2 139 20 2 1
R016 70092      2     140 20
I017 70088 0810 010 024 3 4 01                  1 2 1 110 31 7 1
R017 70089      2     118 30
R017 70098      2     120 28
R017 70119      2     118 30
R017 70120      2     115 25
R017 70125      2     110 30
R017 70234      2     120 27
R017 70239      2     118 35
R017 70249      2     117 28
I018 70088 0835 094 005 1 4 01 001 11 1 2 1 121 37 7 2
M018 70257 1200 6 1 2 116 30
R018 70092      2     121 32
R018 70094      2     121 33
R018 70096      2     121 33
R018 70099      2     118 38
R018 70118      2     120 35
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R018 70126       2      115 25
R018 70128       2      120 35    0
R018 70169       2      115 33    0
R018 70206       2      120 32    0
R018 70175       2      120 37    0
R018 70177       2      120 37    0
R018 70235       2      120 32    0
I019 70088 0850 049 072 1 4 02          1 2 1 121 32 7 1
R019 70091       2      118 30
R019 70093       2      120 30
R019 70094       2      118 38
I020 70088 0908 031 003 1 2 01          1 2 1 118 30 7 1
R020 70093       2      120 25
R020 70095       2      120 25
R020 70097       2      112 30
R020 70098       2      121 37
R020 70100       2      118 30
R020 70106       2      118 30
I021 70088 0919 035 034 3 1 02          2 2 2 115 25 3 1
R021 70092       2      115 26
R021 70095       2      115 25
I022 70088 1022 098 028 5 1 03          1 2 1 139 22 7 1
R022 70093       2      140 20
I023 70089 1330 019 084 3 3 01 001 09 1 2 1 110 35 7 1
R023 70092       2      116 30
R023 70093       2      110 35
R023 70100       2      110 35
R023 70106       2      105 34
R023 70118       2      118 30
R023 70121       2      115 30
R023 70123       2      110 38
R023 70166       2      110 37 2
I024 70089 1435 023 074 1 4 03          1 2 1 121 32 7 1
R024 70091       2      121 32
R024 70093       2      121 32
R024 70126       2      120 30
I025 70089 1537 093 036 4 1 02          1 2 2 125 17 3 1
I026 70089 1615 009 083 5 1 04          1 2 1 137 26 7 1
I027 70089 1630 026 061 5 1 05          1 2 1 138 28 7 1
I028 70089 1640 062 085 5 1 06          1 2 2 139 29 2 1
R028 70092       2      139 29
R028 70095       2      139 39
I029 70090 1400 099 073 5 3 01          1 2 2 139 30 4 1
I030 70091 1420 060 039 3 1 01          2 2 1 115 26 7 1
I031 70091 1540 090 041 5 1 07          1 2 2 139 20 2 1
I032 70091 1625 017 021 5 3 02          1 2 2 139 35 3 1
I033 70092 1430 051 001 3 1 02          1 2 1 113 20 7 1
R033 70093       2      115 25
R033 70097       2      111 20
I034 70092 1500 011 025 4 1 03          1 2 2 124 17 2 1
R034 70094       2      125 18
R034 70096       2      125 18
R034 70098       2      125 18    4
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R034 70100       2      125 18
R034 70107       2      125 18
R034 70155       2      125 18
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M035 70106 1010 6 6 1 120 30
R035 70106       2      120 30
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R036 70096       2      137 28
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