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Sampling Small Mammal Population in Curlew Valley Methodological Study

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PROGRESS REPORT

METHODOLOGICAL STUDY

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METHODOLOGICAL STUDY (2.2.1)

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Abstract

The objectives of this study were to determine the kinds and relative abundance of small mammals at Curlew Valley Validation sites and to select the best practial techniques of assessing their population characteristics. Our approach was to observe and sample with several methods the small mammals near the sites: On the basis of our findings, we concluded the following:

1. One should sample the rodents with a 5-day trapping program that consists of two traps per station positioned 15 m apart on a 12 x 12 grid. The addition of a border strip (Stickel, 1946) would determine the area sampled.

2. One should determine the density of jackrabbits in sage brush with a drive, and in crested wheat with observations at the field borders. Jackrabbit collections near the sites would establish their age, sex, and body weight.

3. Jackrabbits (Lepus californicus), deer mice (Peromyscus maniculatus), chipmunks (Eutamias minimus), and pocket mice (Perognathus parvis/longimembris), respectively, are the small mammal species that have the greatest biomass on the validation sites.

Introduction

The intial task of the validation program is to provide a quantitative description of the state of the sites at a moment in time. For small mammals, this requires a species inventory that includes biomass and age and sex structure of the populations. A meeting of biome vertebrate specialists concluded that accurate species lists, an indication of their relative numbers, and investigations of methods for their inventory would be necessary on the sites before the validation program begins. This study attempts to supply some of this information on small mammals for the Curlew Valley terrestrial validation sites.

We have tentatively selected four, 1 km^2 sites for validation in Curlew Valley: a sage brush and crested wheat area in both the southern and northern part of the valley. Our approach was to observe and sample with several methods the small mammals near each of the four sites from June to November.

Sampling Rodent Populations (Assisted by R. Anderson and G. Wilson)

Objectives

Our primary concern is validating species of rodents which are important with respsect to their biomass or to their effect on other components of the system. However, a species which exhibits irruptive population fluctuations may be low on density at one time and high at another time; and it is difficult to estimate the effect of a species on other parts of the system at this time. Thus, the initial inventory should cover contingencies by obtaining biomass and population characteristics of all rodent species on the sites. This methodological study will assist the inventory by:

1. Determining the kinds and relative abundance of rodents at the four sites.

2. Selecting or developing rodent sampling techniques that provide accurate estimates of population parameters, that cause minimal distrubance to flora and fauna, and that are easily and cheaply applied.

Methods

We attempted to meet the objectives with two trapping programs. We conducted the first immediately adjacent to each of the four proposed validation sites. It consisted of 36 trap stations in a 6 x 6 grid. The stations were 50 m apart to minimize the effect of one upon another. There were 12 independent variables associated with the trap set: all possible combinations of three types of traps (Havahart and Sherman

live traps and Victor snap trap), two types of bait (apple and a mixture of peanut butter and oat meal), and one or two traps at a trap station. The rationale for using the different traps and baits was that each presented a different type of stimulus to the animals and thus could promote different responses that may influence capture success (Huber, 1962; Fitch, 1954). The reason for using either one or two traps per trap station was to see if two traps per station increased capture success significantly.

We assigned the 12 different trap sets to the 36 trap stations in a random manner, checked the sets mornings and evenings for 3 days, and removed from the area those captured. We replicated the procedure four times near each southern site and three times near each northern site. On each replication the trapping grid was 200 m from its position on the previous replication. Thus, we applied the 12 independent variables to 36 trap stations, twice a day, for 3 days, for four replications near two sites, and for three replications near two other sites.

The second trapping program was a conventional one applied to several areas of sage brush near the sites. We used Sherman live traps placed at 25 m intervals on a 10 x 10 grid. After 5 days of live trapping, we ran assessment lines for 3 days to determine the area sample (French et al., 1970).

We hoped that the two programs would meet the objectives by maximizing the chance of capturing the various species that existed in the areas and by giving us some experience in using several trapping techniques.

Findings

The first trapping program captured six species of rodents near the sites (Tables 1-4): chipmunks (Eutamias minimus), pocket mice (Perognathus parvus/longimembris), and deer mice (Peromyscus maniculatus) were the most common by far. However, field sign suggested that the traps captured fewer kangaroo rats (Dipodomys ordi/merriami) and mountain voles (Microtus montanus) than were there. Capture success was uneven through the replications (Table 2) despite the relative homogeneity of the habitat. This apparent clumped dispersion was most marked for deer mice in the south wheat and pocket mice in the north sage. The response of pocket mice on successive days (Table 3) suggests that they initially avoided the traps (Balph, 1968) or that another species in the area restricted their movements (Calhoun, 1963), and thus, the probability of their capture until some of the other species were removed. The type of trap, type of bait, and number of traps used at a trap station all appeared to be important variables in capture success (Table 4). Victor snap traps were the most successful traps on deer mice. The use of two traps per station was more effective than one. The mixture of oatmeal and peanut butter seemed to be the most effective bait.

Table 1. Species captured near four validation sites on three replications.

Species Captured	S. Sage	S. Wheat	N. Sage	N. Wheat
Eutamias minimus	36	2	21	8
Perognathus parvus/longimembris	2	6	25	10
Peromyscus maniculatus	144	48	6	6
Reithrodontomya megalotis	1	0	0	0
Dipodomys ordi/merriami	1	3	0	0
Microtus montanus	0	0	0	0

Table 2. Number of rodents captured near four validation sites on each replication.

Replication	S. Sage	S. Wheat	N. Sage	N. Wheat
First	62	35	15	8
Second	48	7	25	11
Third	75	17	16	8

Table 3. Species captured on successive days near validation sites.

Species Captured	Day 1	Day 2	Day 3
Eutamias minimus	23	30	18
Perognathus parvus/longimembris	11	14	21
Peromyscus maniculatus	95	84	94
Reithrodontomys megalotis	1	2	1
Dipodomys ordi/merriami	3	2	2
Microtus montanus	1	1	0

Table 4. Species captured with 12 different trap sets.

Trap Set	Eut.	Perog.	Peromy.	Reith.	Dipod.	Micro.
1 Havahart/oatmeal	2	7	10	0	0	0
1 Havahart/apple	6	2	9	0	0	0
2 Havahart/oatmeal	18	9	24	0	0	0
2 Havahart/apple	9	7	14	0	0	0
1 Sherman/oatmeal	1	4	4	0	0	0
1 Sherman/apple	1	0	9	0	0	1
2 Sherman/oatmeal	4	4	27	1	1	0
2 Sherman/apple	7	3	15	0	2	1
1 Victor/oatmeal	3	4	38	1	0	0
1 Victor/apple	6	0	26	0	1	0
2 Victor/oatmeal	2	4	54	2	2	0
2 Victor/apple	2	2	43	0	1	0

The second trap program enabled us to make a few rough estimates of rodent density in sage brush areas near the sites. These were: deer mice, 3.5-5 and 8.6-12.9 per ha; chipmunks 6.3-6.5 and 2.6-3.2 per ha; pocket mice 4.2-4.5 per ha. The more dense the population, the more inaccurate these estimates. The 5-day trapping program was not long enough to capture all the animals in dense populations (Figure 1).

Table 5 contains a list of all the small mammals we saw or captured near the validation sites. We estimate that jackrabbits (Lepus californicus), deer mice, chipmunks, and pocket mice, respectively, were the species that had the greatest biomass on the sites.

Discussion

During this study we tended to lose perspective in our attempt to arrive at a sampling program. We were too concerned with the question of accuracy. The real question is how much time and money can we put into sampling the small rodents when they represent such a small part of the biomass at the validation sites? The answer is, not much. Therefore, our recommendation is based more on what we can afford than what we would like to do if we had the time and money. Despite this, we believe that the procedure described below will do an adequate job.

One should sample the rodents with a 5-day trapping program that consists of two traps per station positioned 15 m apart on a 12 x 12 grid. One should set the traps at dark and check them 1-2 hours after sunrise. This would capture the nocturnal rodents and chipmunks. Cumulative capture curves (Figure 1) would indicate whether or not one should continue the program for a few more days. However, the southern sites would begin to appear "grided" by the activity after about 5 days. Four replications of the trapping program within each site (15-20% coverage) should help to cover clumped dispersion patterns and heterogeneity of habitat. One should determine the area sampled with the Stickle (1946) method. This essentially adds to the grid border the radius of the average home range.

Sampling Small Mammal Populations in Curlew Valley - continued

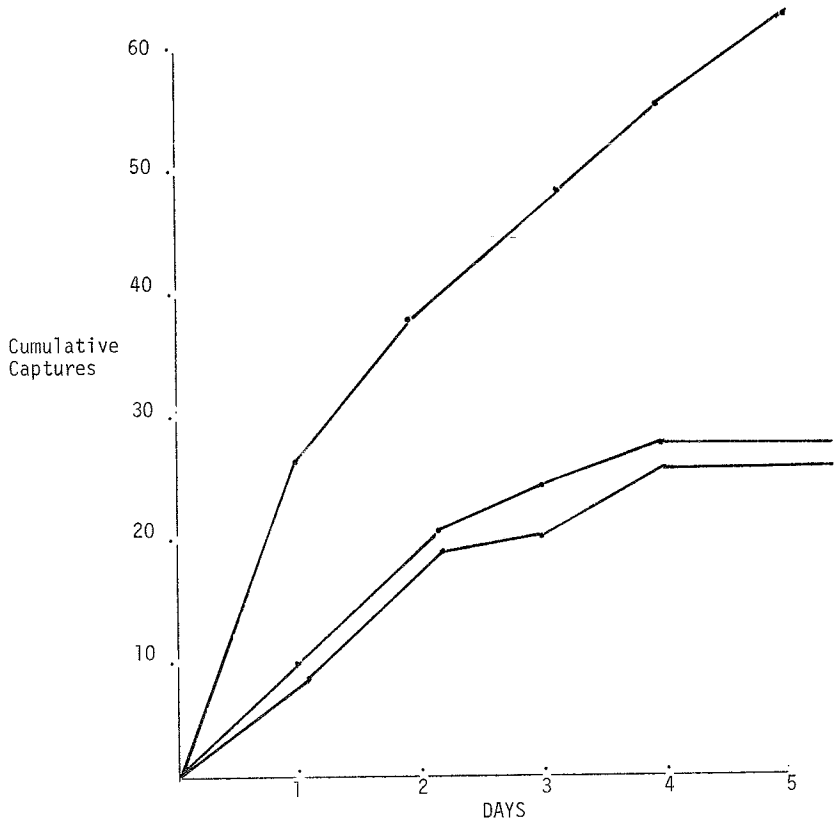


Figure 1. Cumulative number of deer mice captured the first time in 10x10 grid of live traps spaced 25 m apart in three sage brush areas in Curlew Valley.

Table 5. Species list of small mammals seen or captured near four proposed validation sites in Curlew Valley.

Northern Sites

Sage Brush

Jackrabbits (Lepus californicus)
Cottontails (Sylvilagus muttalli)
Deer mice (Peromyscus maniculatus)
Pocket mice (Perognathus parvus/longimembris)
Chipmunks (Eutamias minimus)
Grasshopper mice (Onychomys leucogaster)
Kangaroo rats (Dipodomys ordi/merriami)

Crested Wheat

Jackrabbits (Lepus californicus)
Deer mice (Peromyscus maniculatus)
Pocket mice (Perognathus parvus/longimembris)
Kangaroo rats (Dipodomys ordi/merriami)

Southern Sites

Sage Brush

Jackrabbits (Lepus californicus)
Cottontails (Sylvilagus muttalli)
Deer mice (Peromyscus maniculatus)
Sagebrush vole (Lagurus curtatus)
Chipmunks (Eutamias minimus)
Harvest mice (Reithrodontomys megalotis)
Pocket mice (Perognathus parvus)
Pigmy rabbits (Sylvilagus idahoensis)

Crested Wheat

Jackrabbits (Lepus californicus)
Cottontails (Sylvilagus muttalli)
Deer mice (Peromyscus maniculatus)
Pocket mice (Perognathus parvus)
Kangaroo rats (Dipodomys ordi/mer.)
Pigmy rabbits (Sylvilagus idahoensis)
Mountain vole (Microtus montanus)

Sampling Small Mammal Populations in Curlew Valley - continued

Estimating Jackrabbit Populations

Jackrabbits present the most unique sampling problem among the small mammals at Curlew Valley Validation sites. They readily move some distance from the cover of sage brush, where they spend the day, to areas of crested wheat where they feed during the night. This behavioral pattern necessitates that we treat them as daily inputs and outputs to each site. Thus, the problem is to find the best way to determine biomass and age and sex composition of the populations on sage brush and crested wheat sites through the diel period. Here we shall consider the question of determining jackrabbit numbers in sage brush during the day and in crested wheat during the night.

Sampling in Sage Brush (assisted by J. Stuart)

Objectives

One could logically use three different techniques to assess jackrabbit numbers: (1) trapping, (2) line transect, and (3) drives. We applied these methods in a 2.59 km^2 (one square mile) sage brush study area that F. H. Wagner has used for some years in a jackrabbit investigation. Our objective was to select the best method to use on the sage brush validation sites.

Methods

We trapped two 4 x 5 grids spaced some distance apart in the study area. We placed #108 National live traps baited with apple at 50-meter intervals on the grid and checked them daily for 5 days. We used 20 traps on one grid and 19 traps on the other -- a trap effort of 195 traps days. We tagged and released the animals captured.

On the sixth day a technician walked 14.5 km of line transects in the study area using the method described by Gross (1967). He recorded the flushing distance and angle from the transect line of all jackrabbits he saw.

On the seventh day we conducted a drive of the study site. We drove the area in four 400 x 1,600 m (.25 x 1 mile) segments. Each segment was bordered by a road. There were 32 drivers on the line and about 20 observers on the sides and end of the segment being driven. The drivers counted the animals that went back through the line and the observers counted those that ran out the end and sides of the segment.

Results

The trapping program captured nine jackrabbits on one grid and seven on the other (Table 6). Thirteen were captured only once, two twice, and one five times. There were insufficient captures to make a density estimate. A rough index to density was one jackrabbit per nine trap days of effort. Some rabbits entered the traps on the first day, suggesting that they do not require a few days to habituate. As is common among small mammals, a portion of the population was trap prone.

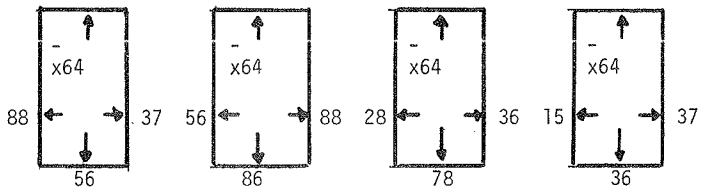
The technician counted 31 jackrabbits on the 14.5 km of transects he walked. The mean flushing distance was about 20 m. The density estimate calculated with the Gates (1969) method was 262 for the study area (about one rabbit per 1 ha).

Personnel counted 816 jackrabbits on the drive of the study area (Figure 2). Some 256 moved back through the drivers, and 560 moved out of the segment being driven (excluding those that could be counted twice).

Table 6. Trap success of jackrabbits on a study site in Curlew Valley.

	Grid 1		Grid 2		
Day	Captures	Recaptures	Captures	Recaptures	
1	3	0	1	0	
2	3	1	1	0	
3	3	1	4	0	
4	0	1	0	0	
5	0	3	1	0	
TOTAL	9	6	7	0	= 22

Sampling Small Mammal Populations in Curlew Valley - continued



TOTAL 186 270 203 156 = 816

Figure 2. Direction of movement and numbers of jackrabbits counted in driving a 2.59 square km^2 study area in four, 400 x 1,600 m segments.

Discussion

A trapping program would provide information on the age, sex, and weight of individuals as well as density -- something the other techniques would not do. However, trapping presents some rather formidable logistic problems caused ultimately by the size and mobility of the jackrabbits. At the present high density on the validation sites and a success of one rabbit per 10 trap days, a 10 x 10 grid operated for 10 days should give a reliable index to density. However, it would cost about $1,500 for the 100 traps to operate one grid. Each trap weighs about 6 kg and a person can only carry four of them any distance. Merely placing the traps on the grid would require a technician to walk some 10 km. At low densities the problems would be greater. From 1964 to 1968 the density of jackrabbits on the study site was never more than 100. At these densities we doubt that any practical trapping program would capture enough rabbits to provide even a good index to density. We hesitate to consider the effort it would take to determine a weighting factor with a trapping program.

The line transect is an easy sampling method to apply. It requires no equipment, and one technician can walk up to 15 km of transects a day. However, we question the reliability of the estimate obtained, even as an index. The estimate of 262 jackrabbits obtained with 14.5 km of transects was only 32% of the 816 rabbits that were on the site. Some 6 weeks before this estimate was made, 6.4 km of transects in the study area gave an estimate of 160 rabbits; only 19% of the rabbits that were there (assuming no change in density in 6 weeks).

There are perhaps two basic problems with the line transect when applied to jackrabbits. The first is the large variation in the number of rabbits seen per unit of transect walked. Since 1963 the four 1.16 km transects walked in the study area have estimated 0-230% of the rabbits that personnel counted on the drives (F. H. Wagner, unpublished data). However, L. C. Stoddart (personal communication) has evidence that one can obtain a more reliable index to jackrabbit density by increasing the number of transects. This would entail replication on the validation sites since nine 1 km transects are about the most that one can fit into the 1 km^2.

The other problem with the transect method is that as an index it must have a weighting factor. L. C. Stoddart (personal communication) has estimated through experimentation that determinations made with the technique underestimate the population by 30%. Some recent evidence suggests this figure is larger when the density is high. A greater percentage of the rabbits seen flush at a greater distance (L. C. Stoddart, unpublished data), and we believe a greater percentage exhibit sneaking behavior while moving away from the observer.

A well conducted drive is perhaps the most quick and accurate method of determining numbers of jackrabbits on the sites. We estimate that 35 people could adequately census 1 km^2 in approximately 2 hours. About the only significant source of error stems from a failure of the driving line to flush the rabbits. However, as long as the drivers are no more than 20 m apart, we believe the error is acceptably small.

The following design is satisfactory at Curlew Valley (Figure 3): To drive the first 500 x 1000 m segment (Figure 3A), the drivers (1-25) line up at one end at 20 m intervals. They drive through the segment in a straight line aided by orientation markers. Each driver records the number of jackrabbits that move back through the line between himself and the next driver on the left. The stationary observers

(26-35) position themselves on towers or stepladders at the sides and end of the segment and observe in the direction indicated (Figure 3A). Those positioned on the outside of the segment (32-35) record the number of jackrabbits that move out of the segment between themselves and the next observer until the drive line is opposite their position. Those positioned on the inside of the segment (26-29) do the same, except that they remain in position after the drive line passes and record the number and direction of jackrabbits moving between the segments. Those observers at the segment end (31 and 32) record the number of jackrabbits that move out of the segment. To drive the second segment, personnel take the positions indicated (Figure 3B). The drive then proceeds as before with the tasks of the drivers and observers the same as in driving the first segment. To determine the number of jackrabbits in the area, one simply sums the rabbits seen passing back through the line with those seen moving out of the segments. Care must be taken to sum only once those rabbits seen moving back and forth between the segments by the observers on the inside borders of the segments (26-29).

In summary, we recommend the following to determine the density of jackrabbits on the sage brush validation sites:

1. If one has the manpower, we believe that a drive of the site is best. One should drive the square kilometer in two segments with a minimum of 25 drivers and 10 observers positioned on portable towers on the sides and end of the segment being driven.

2. If one does not have the manpower, we believe one should use the line transect. We suggest a maximum of nine, 1-km transects (walked in 250 m legs to form a square) per 1 km^2 site. One should replicate the procedure every other day for 10 days. Thus the estimate, which L. D. Stoddart thinks should be arrived at with the Gates (1969) method using pooled data, would be based on 45 km of transects. For the present, we shall assume that the estimate is 70% of the actual numbers.

3. Collections of jackrabbits made on areas near the validation sites would determine the mean body weight and sex and age structure of the population.

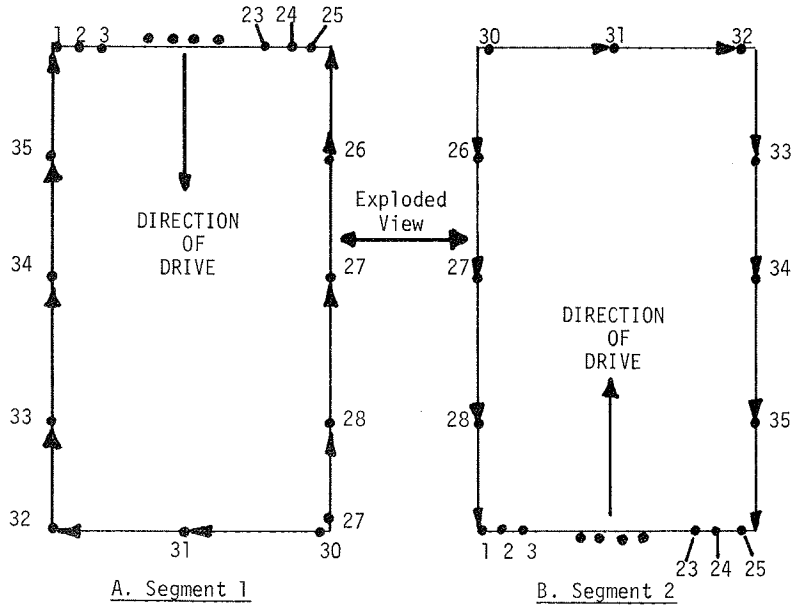


Figure 3. Position of personnel in driving two 500x1,000-m segments of 1 km^2 validation site.

Sampling Small Mammal Populations in Curlew Valley - continued

Sampling in Crested Wheat (Assisted by R. Anderson)

Objectives

We have little knowledge about the daily movement of jackrabbits back and forth between the sage brush and crested wheat sites other than that it occurs. Thus, we decided that the best thing to do at first was simply to observe the phenomenon.

Methods

From July-September we observed jackrabbits from vantage points along the roads that separated crested wheat from sage brush areas. The observation times were in the evening before the rabbits began crossing into the crested wheat until dark, and in the morning from dawn until all the rabbits moved back into the sage brush.

Additionally, we made road-side counts from a moving vehicle along 24 km of roads at the edge of crested wheat areas. It took about 2 hours to travel the route. The vehicle had a row of stationary spot lights directed 45° to the side of the headlights. We drove the route immediately after dark, after midnight, and before dawn.

Findings

Jackrabbits began moving from the sage brush cover into the crested wheat as early as 2 hours before dark. Most of their movement through the sage brush was on small trails through dense cover. Thus, rabbits arrived at the crested wheat at points where the adjoining sage brush was the most dense. Many of the animals stopped on the road before crossing into the crested wheat. There they engaged in a variety of maintenance and social activities. They sat, groomed, played, and sometimes threatened each other. The frequency at which they moved back into the sage brush reflected these behavioral patterns (Table 7). The peak of movement into the crested wheat was during the hour preceding darkness. Rabbits tended to move back to cover in response to disturbances such as the approach of a vehicle.

In the morning jackrabbits moved back into the sage brush more directly and quickly. Few of them stopped on the road and engaged in other activities. The peak of movement to sage brush was between dawn and sunrise.

On the road-side counts we saw an average of about five jackrabbits per km of route driven. These were on the road or in the crested wheat. Of the rabbits seen, about 97% were Lepus and 3% were Sylvilagus. The latter were always close to the sage brush border.

Periodically we walked through the crested wheat areas during the day to look for signs of jackrabbit activity. From the frequency of cuttings and droppings, it appeared that they restricted most of their activity to a 300-500 m belt of crested wheat adjacent to the sage brush areas. However, none of the crested wheat was free from jackrabbit sign, even 2 km from the nearest sage brush.

Table 7. Number of jackrabbits seen crossing a specific 200 m segment of road separating crested wheat and sage brush sites.

Date	Time of First Crossing	Crossed into Crested Wheat	Crossed into Sage Brush
July 7	7:30 p.m.	20	1
July 8	8:39 p.m.	28	17
July 9	8:44 p.m.	7	1
July 10	--	13	2
July 11	7:16 p.m.	74	27
July 12	8:29 p.m.	30	3
July 14	9:08 p.m.	12	5
July 15	9:16 p.m.	9	1
	Last Crossing		
July 12	6:10 a.m.	0	36
July 13	6:15 a.m.	0	36
July 15	6:16 a.m.	0	48
July 16	6:20 a.m.	1	16

Discussion

We believe that jackrabbits at their present density in Curlew Valley exert considerable grazing pressure on the crested wheat sites. The sites seem to draw the animals from sage brush areas some distance away. However, we still know little about the apparent flux in dispersion pattern through the day and season in and around the proposed validation sites.

Our first impression was that the movement into and out of the sites could best be determined with a device that counts the number of times a beam of light is interrupted. Such a device positioned on a road next to the sites would then count the rabbits as they moved back and forth. However, it quickly became apparent that the animals' behavior on the road would cause difficulty. Even if the problem of determining direction of movement were solved, we believe that rabbits sitting in the path of the beam would interrupt it for significant periods of time.

On the basis of our observations thus far, we recommend the following methods to measure population parameters of jackrabbits in crested wheat:

1. We believe that one should monitor the movement, and thus density, of jackrabbits into and out of the site by direct observation. The observation should be made from portable towers with the aid of "night optics" and perhaps lights.

2. We recommend that one should place the crested wheat sites next to the sage brush sites. This would simplify the logistic problem in that inputs to one site would be outputs to the other site.

3. We think that time-lapse photography from a tethered balloon over the sites would be more accurate and efficient than direct observation. Such a system should be developed, if possible.

4. The mean body weight and sex and age structure of the population should come from the collections made for the sage brush site. However, those rabbits collected should have the same nutritional opportunities as the rabbits on the validation sites.

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