

Estimation of Herbage Intake from Jackrabbit Feces¹

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Highlight

The rate of dry weight intake of blacktailed jackrabbits (*Lepus californicus*) in northeastern Colorado was calculated from records for the rate that fecal pellets were deposited on permanent plots. The indigestibility of the native sandhill range forage was estimated from values in the literature (Arnold and Reynolds, 1943). It was estimated that if the range forage removed by jackrabbits had been eaten by yearling steers the value of the beef might have amounted to \$9.35 per hectare per year (or \$3.70/acre/year).

Most methods studied for estimating herbage intake of leaf-eating herbivores have been concerned with the potential use of indicators found in the solid excreta. These methods require precise knowledge about the indicator (substance or substances) in the food eaten and in the feces. The quantity of leafy material consumed on rangeland can be estimated from fecal output if the indigestibility of the forage consumed and the quantity of feces produced per unit of time per

unit of area are known. Total fecal collections from livestock have been obtained by means of animals trained to "harnesses" with fecal collection bags. Wild herbivores, such as jackrabbits, cannot withstand such stress. The difficulties in obtaining total collection estimates of fecal output in livestock may be circumvented for jackrabbits by using permanent plots from which the rabbit fecal pellets are harvested at regular intervals. In essence, appropriately sized permanent plots, of sufficient number, distributed and spaced in

a regular-random pattern might serve as sub-sample units for predicting total fecal production.

The purpose of this manuscript is to describe the seasonal trends in the numbers and oven dry weights of fecal pellets voided by blacktailed jackrabbits (*Lepus californicus*) at the Eastern Colorado Range Station in the years 1968 to 1970.

Methods and Materials

This study was conducted on the Eastern Colorado Range Station approximately 27 kilometers north of Akron in Washington County, Colorado. The diet and forage preferences of blacktailed jackrabbits were studied here by Sparks (1968) and he has described the study areas.

Twenty-four sampling sites, each about 0.2 hectares (one-half acre), were used for this study. Twelve sampling sites grazed by cattle were paired in the same pasture with twelve "enclosures" to cattle and the paired sites were both on the same soil types. They were located in a linear north-south direction in a restricted random arrangement.

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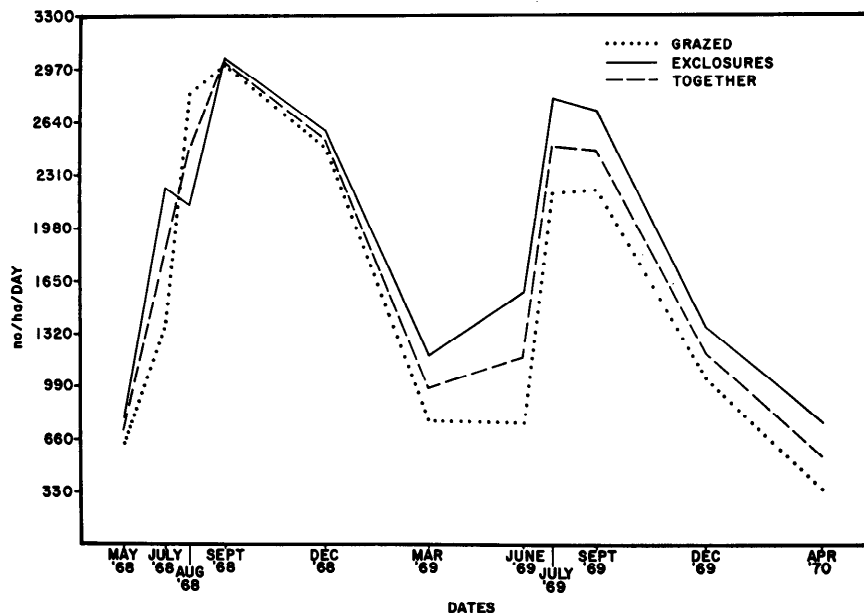


FIG. 1. The calculated numbers of blacktailed jackrabbit pellets voided per day in northeastern Colorado native sandhill rangeland for cattle grazed pastures and exclosures to cattle within pastures.

The distances between paired sampling sites averaged .7 km. The exclosures to cattle had been established for 6 or more years and they did not exclude rodents, rabbits or other small animals.

Fecal pellets of rabbits were col-

lected from 20 permanently marked locations within each site grazed by cattle and each exclosure. A 30 cm by 50 cm quadrat was placed on the ground at each of the locations and all pellets within the quadrat were counted, collected,

oven dried and weighed. Pellets near the quadrat boundary but on the outside were removed and discarded. All pellets were counted and removed one month prior to the first collection period (May, 1968). The fecal pellets of rabbits were counted and collected eleven times, at about 3 month intervals, from May 1968 until April 1970. Counts of pellets have been used as a method of estimating jackrabbit densities (Taylor et al., 1935; Phillips, 1936; Arnold and Reynolds, 1943).

Results

There was no detectable relationship between jackrabbit pellet production and cattle grazing intensity or soil type, in the study area. When the overall harvest for number and dry weights of jackrabbit pellets was compared for the "paired" cattle grazed and ungrazed sites there was a small but highly significant difference (Figure 1). In August 1968 the mean numbers of pellets produced per day was greater on the grazed (2859/ha/da) than on ungrazed sites (2153/ha/da) but the difference was not statistically significant. For the April 1970 collection there was significantly more jackrabbit pellets being voided on the ungrazed sites (782/ha/da) than on the grazed sites (365/ha/da).

The ungrazed sites produced jackrabbit pellets whose mean dry weight was 0.01 g less than those on the grazed sites. However, within any one collection date the difference in the mean weight of a pellet was not statistically different between the grazed and ungrazed sites.

The number of fecal pellets voided and dry weight of pellets voided was significantly less in the summer of 1969 than in 1968 (Table 1 and Fig. 2). The above-ground herbage and plant composition on the study pastures was not significantly different between 1968 and 1969 (unpublished data). The maximum forage availability was in June and the minimum in

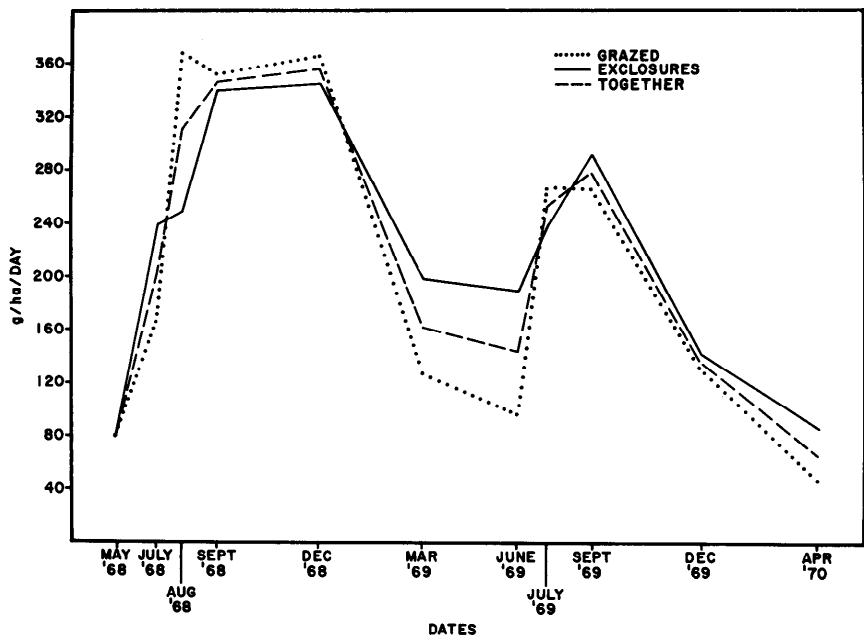


FIG. 2. The calculated weight of blacktailed jackrabbit pellets voided per day in northeastern Colorado native sandhill rangeland for cattle grazed pastures and exclosures to cattle within pastures.

April. The maximum jackrabbit defecation rate lags 3 months behind the season of maximum plant biomass but the minimum defecation rate appears to occur with the season for minimum plant biomass.

Discussion

A technique was developed for estimating the relative abundance of various plants in the diets of leaf-eating herbivores (Sparks and Malechek, 1968; Hansen and Ueckert, 1970). To convert these data to absolute quantities, total daily intake of dry matter is needed. The attempts generally used in estimating dry matter intake by freely grazing time herbivores are: (1) pasture production assessments; (2) consumption—defecation ratios; (3) non-digestible indicators; and (4) fecal nitrogen.

The average daily consumption of range-type forage fed penned blacktailed jackrabbits, expressed as a percentage (dry matter intake/live body weight), was about 6.6% (Arnold, 1942). The average apparent digestion of dry matter for penned blacktailed jackrabbits fed range type forage was 45% (Arnold and Reynolds, 1943). This is about the same average dry matter digestion that is reported for livestock under winter range conditions (Cook and Harris, 1968). The dry matter digestion for livestock fed (summer) growing plants as northeastern Colorado averaged 69% and only 44% when they were fed (winter) quiescent range plants (Wallace and Denham, 1970). I believe the dry matter digestion of native range forage when selected under natural conditions by jackrabbits may be similar to that of livestock.

Directly measured values for digestion of dry matter by jackrabbits are not available from northeastern Colorado but if we assume the jackrabbit values measured in Arizona by Arnold (1942) and Arnold and Reynolds (1943) are approximately correct for northeastern Colorado, the dry weight

Table 1. The average dry weight (grams) of rabbit pellets, the calculated dry weight (grams) of rabbit feces voided, and the calculated number of pellets defecated per hectare per day for samples collected from northeastern Colorado 1968–70.

Date of collection	Mean dry weight of pellet	Estimated mean dry weight/ha/da	Estimated mean number of pellets/ha/da
April 15, 1968	0.14		
May 29, 1968	0.11	80	727
July 10, 1968	0.11	203	1819
Aug. 5, 1968	0.12	311	2506
Sept. 9, 1968	0.11	349	3064
Dec. 17, 1968	0.14	359	2582
March 25, 1969	0.16	164	992
June 25, 1969	0.12	145	1189
July 23, 1969	0.10	256	2531
Sept. 3, 1969	0.11	282	2503
Dec. 18, 1969	0.11	139	1220
April 11, 1970	0.12	69	574
Overall mean	0.12	214	1792

of forage consumed by jackrabbits can be calculated for the study area.

$$\begin{aligned} \text{Forage removed} &= \frac{\text{dry weight of feces produced}}{1 - \text{digestion index}} \times \text{time} \\ \text{or} \\ \text{Forage removed} &= \frac{214 \text{ g/ha/da}}{1 - .45} = 389 \text{ g/ha/day} \end{aligned}$$

If 389 grams of forage eaten equals 6.6% of the live jackrabbit biomass, and if the jackrabbits averaged 2.1 kg in live weight, there was an average of about 3 jackrabbits per hectare during the study. If we estimate the mean rabbit density for the study area based on 545 ± 42 pellets per jackrabbit per day (Arnold and Reynolds, 1943) there was also about 3 jackrabbits per hectare.

The digestibility of range forage by "adult-sized" jackrabbits appears to affect mean pellet weight (Arnold and Reynolds, 1943). In Arizona, blacktailed jackrabbits whose mean dry matter digestion index was 45% voided pellets whose mean dry weight was 0.12 g (*loc.*

cit.). When jackrabbits ate a diet with a dry matter digestion index of 60% their pellets average 0.10 g and when the digestion index was 32% the rabbits lost body weight and voided pellets that averaged 0.14 g (*loc. cit.*). The overall mean weight of jackrabbit pellets in my study was 0.12. In summer when the body size of jackrabbits would average smaller (because of young jackrabbits) than in winter and forage is likely to be more digestible than in winter the pellets tended to be lightest in weight (Table 1). In winter when all jackrabbits on the study area are adult-size and are most likely to be forced to eat low quality dry forage, the mean pellet weight tended to be highest.

The impact of jackrabbits on rangeland can be demonstrated by considering herbage as a source of energy for the production of "carcass meat" (Cook, 1971). A reasonable assumption is that yearling cattle on the study area gain about 1 kg in body weight for each 10 kg of herbage consumed. Practically all plants eaten by jackrabbits are consumed by cattle when they are available to cattle. Let

us assume that each 10 kg of herbage eaten by jackrabbits is worth a kg of beef. If beef is worth about 66 cents per kg the value is about \$9.35 per hectare per year (about \$3.70/acre/year). There are about 2×10^6 acres of range classified as "deep sand" and "sandy plains" in eastern Colorado. Therefore, the loss of forage to jackrabbits might have been worth 7.4 million dollars for the years 1968-1970 had yearling steers been used to harvest the forage instead of jackrabbits. The value that jackrabbits contribute to esthetics and hunting recreation should be subtracted to obtain a net value of the jackrabbits' worth to Colorado.

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