Seasonal Foods of Blacktail Jackrabbits and Nuttall Cottontails in Southeastern Idaho

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Abstract

The diets of blacktail jackrabbits *(Lepus californicus)* and nuttall cottontails *(Sylvilagus nuttalli)* were estimated by examination of fecal pellet botanical composition. The deficiencies of fecal analysis are noted, but dietary trends and relative importance of forage plants are accurate. Cluster analysis combined leporid pellets into 2 distinct groups based on botanical composition, representing feeding during spring-summer and fall-winter periods. Seven variables (plant species) accounted for significant differences ($P<0.05$) within and among the leporids studied in seasonal food selection. Generally, grasses and forbs were most abundant in blacktail jackrabbit and nuttall cottontail pellets during the spring-summer period, whereas shrubs were most abundant during the fall-winter period. Diet similarity was greatest between blacktail jackrabbits and nuttall cottontails during the same season. Diversity of forage consumed was greatest for both leporids during spring-summer periods. Habitat segregation minimizes competition for forage between the leporids studied. Livestock grazing appears to limit leporid population density rather than alter leporid food habits.

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Leporids play a major role in the ecology of the Great Basin area of the western USA. They compete with livestock and other wildlife for forage, cause extensive crop damage, and are a major food source for coyotes (Clark 1972, MacCracken and Hansen 1982a) and other predators which in turn kill livestock and game animals.

Leporids are primarily herbivorous, but have been reported to consume carrion (Hansen and Flinders 1969, DeCalesta 1971). When jackrabbits (*Lepus* spp.) become overly abundant, about every 10 years, their impact on the ecosystem is tremendous. In January 1982 such a situation existed, and it was estimated that local people killed about 64,000 jackrabbits during 6 different roundups at Mud Lake, Ida., bordering our study area. Information on food selection by jackrabbits during low and high population levels helps to determine if such controversial management procedures are justified.

The foods of most species of leporids have been documented in the literature (Hansen and Flinders 1969, DeCalesta 1971). Feeding by blacktail jackrabbits *(Lepus californicus)* may have been the most thoroughly examined (Uresk 1978, Westoby 1980).

Even though studies dealing with leporid food habits have been published, few have investigated seasonal food selection by sympatric leporids. The purpose of this paper is to present the results of a study which examined seasonal food habits of sympatric blacktail jackrabbits, and nuttall cottontail *(Sylvilagus nuttalli)* in southeastern Idaho when the jackrabbit population was at low levels.

Study Area

This study was conducted on the Idaho National Engineering Laboratory (INEL) site, which occupies approximately 231,500 ha of the upper Snake River Plain in southeastern Idaho, a part of the northern cold desert biome. The geology and climate of the Snake River Plain were described by Eggler (1941). Most of the INEL site was dominated by big sagebrush *(Artemisia tridentata)* associations (Harniss and West 1973, Anderson and Holte 1981). Major shrubs other than big sagebrush present on the study area were rabbitbrush (*Chrysothamnus* spp.), horsebrush (*Tetradymia*, spp.), saltbush (*Atriplex* spp.), and spiny hopsage *(Grayia spinosa)*. Common winterfat *(Eurotia lanta)* was abundant on the INEL site and frequently occurred in large, nearly pure stands. The most abundant grasses on the study area were wheatgrass (*Agropyron* spp.), Indian ricegrass *(Oryzopsis hymenoides)*, bottlebrush squirreltail *(Sitanion hystrix)*, and bluegrass (*Poa* spp.). Some important forbs were vetches *(Astragalus* spp. and *Vicia americana)*, pinnate tansymustard *(Descurainia pinnata)*, buckwheat (*Eriogonum* spp.), common halogeton *(Halogeton glomeratus)*, munro globemallow *(Sphaeralcea munroana)*, and Hood phlox *(Phlox hoodii)*.

Domestic sheep and cattle grazed peripheral portions of the INEL site. Livestock have not been permitted on the central portion of the study area for over 25 years. Pronghorn *(Antilocapra americana)* were abundant on the INEL site, and mule deer *(Odocoileus hemionous)* were relatively scarce. Wapiti *(Cervus elaphus)* have been occasionally observed on the study area (O.D. Markham, pers. comm.). Whitetail jackrabbits (L. *townsendii*) were also present, but rare, and were observed only along northern and western borders of the INEL site (MacCracken 1980).

Methods

Leporid food habits were determined through microhistological examination of plant fragments in leporid feces as described by Sparks and Malechek (1968) and Hansen and Flinders (1969). Differential digestion of different plants and plant parts produces bias when feces are used to estimate diets (Anthony and Smith 1974, Westoby et al. 1976, Vavra et al. 1978, Holechek et al. 1982). Methods have been developed that partially correct for this bias (Vavra et al. 1978, Holechek et al. 1982); however, we assume that biases remained constant. Vavra et al. (1978) stated that dietary trends and relative importance (by rank) of forage plants are accurate when using feces to estimate diets.

Twenty-five random sites were selected for study and sampled once each season per year during the 2-year period from October 1977 through July 1979. The sites were either grazed or ungrazed by livestock. At each site there were 20 permanent 1-m^2 plots which were treated as one sample area. At each site and sample time all fresh pellets were picked up, dried, and weighed. A sample of material from 5 blacktail jackrabbit and 5 nuttall cottontail pellets were mounted on slides. For each set of 5 slides, 100 microscope fields were viewed at 100X, 20 per slide. Plant fragments were identified to species by characteristics of epidermal cells. The actual data taken were plant species frequency per 100 fields examined, expressed as percent relative density (Sparks and Malechek 1968).

Pellet Identification

Leporid pellets were separated into 2 groups based on size and weight. The heaviest pellets were identified as jackrabbit, the others as nuttall cottontail (MacCracken and Hansen 1982b). Using this procedure, it would be possible to mix juvenile jackrabbit pellets with nuttall cottontail pellets. However, mixing of pellets would be insignificant. Mixing would occur only during the period when young jackrabbits were present. The literature indicates that blacktail jackrabbits give birth from February through May in the Great Basin area (Gross et al. 1974, French et al. 1965). Jackrabbits also complete the majority of their growth within 70 days (Haskell and Reynolds 1947) and can reach adult size in 98 days (Tiemeier 1965). These facts indicate that only spring collections would have a mixing of jackrabbit and cottontail pellets. In addition, the sedentary and secretive behavior of juvenile jackrabbits (Tiemeier 1965) would decrease the probability of juvenile jackrabbit pellets being harvested from the plots.

Leporid Foods

After preparation of nuttall cottontail and blacktail jackrabbit pellets, we randomly selected 10 samples from each leporid species for each of 8 collection dates and 2 areas (livestock grazed and ungrazed) of the INEL site for statistical analysis. Our sample array size (400 diet estimates × 25 forage items) had to be reduced due to limited computer memory. Since leporid distribution on the INEL site is nonrandom with respect to grazing and collection factors, 10 samples were not available for some factors. Overall, 114 and 108 samples were analyzed representing blacktail jackrabbit, and nuttall cottontail food habits, respectively. We suspected that significant seasonal differences existed in jackrabbit and cottontail food habits. Exactly how the data were structured was unknown. For example, on a calendar basis there are 4 seasons per year; however, that may not be biologically relevant. One way to approach the problem would be to arrange the data into 4 seasonal groups, based on date of collection, and make appropriate statistical tests, pooling data from nonsignificant groups. However, a less tedious approach is to examine the data with a cluster analysis algorithm and determine if the resulting groups are interpretable on a seasonal basis. The latter method was used in this study. Seasonal foods of each species were tested for differences among species, and seasons of feeding with multivariate analysis of variance (MANOVA) (Cooley and Lohnes 1971). Differences were considered significant at the 5% level of probability.

Diet overlap was estimated using Kulcynski's similarity index (Oosting 1956) and diet diversity (H') using the Shannon-Weiner formula (Hurtubia 1973).

Plant names follow those given by Scott and Wasser (1980) or Beetle (1970).

Results

Seasonal Foods

Cluster analysis of blacktail jackrabbit and nuttall cottontail samples arranged the data into at least 2 groups that represented feeding during the plant growing season (spring-summer) and nongrowing season (fall-winter) for each leporid species. MANOVA tests indicated that all seasonal and species comparisons were significantly different ($P<0.01$) and that 7 forage species accounted for the differences. Those plants were big sagebrush, common winterfat, sedges (*Carex* spp.), vetches, needleandthread grass *(Stipa comata)*, wheatgrasses, and saltbush.

Spring-summer foods of blacktail jackrabbits consisted of 43% grasses, 10% forbs, and 46% shrubs (Table 1). The most abundant grasses and grasslikes in blacktail jackrabbit pellets at that time were wheatgrasses and sedges. Important forbs were common halogeton and the other forb category, which was a composite of many species. Major shrubs were common winterfat and big sagebrush.

Fall-winter foods of blacktail jackrabbits consisted of 9% grasses, 6% forbs, and 85% shrubs (Table 1). Important grasses were wheatgrass and bluegrass. Abundant forbs and shrubs were the same as in spring-summer diets. Common winterfat increased about 3-fold in fall-winter samples of blacktail jackrabbits compared to spring-summer samples.

Nuttall cottontail foods during spring-summer were made up of 78% grasses, 11% forbs, and 11% shrubs (Table 1). Major grasses were wheatgrass and needleandthread grass. Abundant forbs were milkvetch (*Astragalus* spp.) and bluebells (*Mertensia* spp.). Important shrubs were common winterfat and big sagebrush.

Fall-winter foods of nuttall cottontails consisted of 22% grasses,

Table 1. (Mean ± SE) percent relative density of plant fragments found in leporid feces collected from the Idaho National Engineering Laboratory site, and diversity for each diet estimate.

	Blacktail jackrabbit		Nuttall cottontail	
Plant species	sp-su[1]	f-w	sp-su	f-w
Agropyron spp.	37 ± 6	5 ± 2	56 ± 4	6 ± 1
Carex spp.	2 ± 2	*	*	1 ± 1
Oryzopsis hymenoides		1 ± 1	1 ± 1	*
Poa spp.	1 ± 1	2 ± 1	1 ± 1	*
Stipa comata	2 ± 1	1 ± *	18 ± 3	3 ± 1
Other grasses	2 ± 1	*	3 ± 1	1 ± *
Antennaria spp.				2 ± 2
Astragalus spp.	1 ± 1	1 ± 1	2 ± 1	11 ± 4
Balsamorhiza sagittata			1 ± *	*
Descurainia pinnata	*		1 ± 1	
Erigeron spp.	1 ± 1		*	
Halogeton glomeratus	1 ± 1	2 ± 1	*	1 ± *
Kochia scolparium	*	*	*	*
Mertensia spp.	*		3 ± 1	1 ± *
Other forbs	7 ± 3	3 ± 2	3 ± 1	1 ± 1
Artemisia tridentata	8 ± 4	1 ± 1	3 ± 1	4 ± 1
Atriplex spp.	3 ± 1	*	2 ± 1	1 ± 1
Eurotia lanata	28 ± 6	82 ± 5	6 ± 2	59 ± 6
Chrysothamnus nauseosus	4 ± 3		*	
Opuntia polyacantha	3 ± 2	1 ± 1	*	1 ± *
Diversity (H')	1.9	.9	1.7	1.4

*<1%
[1]sp-su = spring-summer diets; f-w = fall-winter diets.

16% forbs, and 62% shrubs (Table 1). Important grasses and grasslikes were wheatgrass and sedges. Major forbs were milkvetch and pussytoes (*Antennaria* spp.) Abundant shrubs were common winterfat and saltbush.

Diversity was generally highest for nuttall cottontail samples followed by blacktail jackrabbits during the fall-winter period and highest for blacktail jackrabbits followed by nuttall contails during spring-summer (Table 1).

Diet overlap was highest for blacktail jackrabbit fall-winter and nuttall cottontail, fall-winter samples (71%). Blacktail jackrabbit spring-summer and nuttall cottontail spring-summer diet similarity was the next highest (56%) (Table 2).

Table 2. Similarity indices comparing diets of 2 leporids during spring-summer and fall-winter periods in southeastern Idaho.

Relationship	Percent similarity
Blacktail jackrabbit, spring-summer vs.	
Blacktail jackrabbit, fall-winter	44
Nuttal cottontail, spring-summer	56
Nuttall cottontail, fall-winter	44
Blacktail jackrabbit, fall-winter vs.	
Nuttall cottontail, spring-summer	21
Nuttall cottontail, fall-winter	71
Nuttall cottontail, spring-summer vs.	
Nuttall cottontail, fall-winter	23

Discussion

Leporid Foods

Many published studies have indicated that blacktail jackrabbits consume grasses, forbs, and other succulent plants during the plant growing season, then switch to shrubs as a major forage during periods of plant dormancy (Hansen and Flinders 1969, Uresk 1978, Westoby 1980). Grasses and shrubs were important in the diet of blacktail jackrabbits during the growing season in this study. Grass and forb consumption decreased during the fall-winter period while shrub consumption nearly doubled. Johnson (1979) also reported grasses and shrubs to be major foods of blacktail jackrabbits on the INEL site.

Generally, it has been concluded that blacktail jackrabbits select succulent plants during dry periods. Precipitation is greatest in spring on the INEL site (Anderson and Holte 1981). Many blacktail jackrabbit habitats lack free water during dry periods, including most of the INEL site. Westoby (1980) found that stomach contents of blacktail jackrabbits in Utah were often dominated by common halogeton in summer and suggested that this plant was eaten for its high water content. Common halogeton was relatively unimportant in the diets of blacktail jackrabbits on the INEL site even though it was the major forb consumed (Table 1). MacCracken and Hansen (1982b) found that the above-ground standing crop of common halogeton was relatively low in areas of the INEL site where blacktail jackrabbits were most abundant. Hansen and Flinders (1969) suggested that common winterfat was also selected by blacktail jackrabbits for its water content. Riegel (1942) and Brown (1947) reported plains pricklypear to be consumed by blacktail jackrabbits. In this study, wheatgrass, common winterfat, common halogeton and plains pricklypear were the major succulent forages eaten by blacktail jackrabbits during late summer, fall, and winter.

During the period of plant dormancy common winterfat dominated blacktail jackrabbits diets on the INEL site. Plant species diversity was lowest for blacktail jackrabbits during fall-winter. Common winterfat was reported by Hayden (1966) and Currie and Goodwin (1966) to be a major forage of blacktail jackrabbits in Nevada and Utah, respectively.

MacCracken and Hansen (1982b) found that in areas where blacktail jackrabbits were most abundant during fall, winter, and spring on the INEL site, biomass of grasses and grasslike plants was significantly higher than in areas where blacktail jackrabbits were least abundant. They concluded that production of herbaceous plants was important to leporids due to the high abundance and uniform distribution of shrubs on the INEL site, suggesting that it may be advantageous for blacktail jackrabbits to occupy areas where grasses and grasslike plants are abundant to take advantage of any late winter or early spring growth by these plants.

There is relatively little information concerning nuttall cottontail food habits (DeCalesta 1971). Orr (1940) stated that nuttall cottontails subsisted on big sagebrush in California. Big sagebrush was not an important shrub in nuttall cottontail diets on the INEL site. However, common winterfat accounted for 59% of nuttall cottontail fall-winter diets.

Shrubs were more important in nuttall cottontail diets during the fall-winter period than during spring-summer in this study (Table 1). Forb consumption was also highest during this period. Wilde (1978) also noted an increase in shrub and forb consumption by nuttall cottontails on the INEL site during fall and winter. MacCracken and Hansen (1982b) reported forb biomass to be significantly higher in areas of the INEL site where nuttall cottontails were most abundant than in other areas. It has generally been concluded that cottontails (*Sylvilagus* spp.) consume a wide variety of plants (Fitch 1947, DeCalesta 1971, Turkowski 1975, Hansen and Gold 1977). Plant species diversity for nuttall cottontail diets averaged 1.5 which was higher than average diet diversity of blacktail jackrabbits (1.4).

Diet Overlaps and Diversity

Competition for available forage may play an important role in the distribution of nuttall cottontails and blacktail jackrabbits on the INEL site. MacCracken and Hansen (1982b) reported that blacktail jackrabbit and nuttall cottontail abundance on the study area was inversely related. Diet similarities were highest when comparing these two species' diets during the same time period. Generally, similarity between nuttall cottontails and blacktail jackrabbits was highest during the fall-winter period (71%), when forage was least abundant. Competition for forage between these

leporids is minimized due to the habitat segregation observed by MacCracken and Hansen (1982 b).

It appears that livestock grazing on peripheral portions of the INEL site does not alter the availability of preferred forage enough to influence jackrabbit and cottontail food habits. The fact that pellets from grazed and ungrazed portions of the study area clustered in similar groups supports this contention. However, MacCracken and Hansen (1982b) reported that leporids were most abundant in ungrazed portions of the INEL site. These data suggest that livestock grazing may reduce forage availability to the point that it limits leporid population densities in peripheral portions of the INEL site. Johnson (1979) stated that serious competition for forage among leporids and livestock could occur on the INEL site depending on livestock stocking rates, as diet overlaps were greater than 50%. In periphreal portions of the study area, blacktail jackrabbits and nuttall cottontails are probably competing for forage with livestock. MacCracken (1980) suggested that much of the peripheral portion of the INEL site was heavily grazed by livestock.

Diversity of diets was greatest for spring-summer periods for each leporid species studied which reflects utilization of the greater availability and nutrient content of herbaceous plants present at that time. There was relatively little difference between seasons in nuttall cottontail diet diversity, even though the 2 diet estimates were only 20% similar. Examination of Table 1 indicates that seasonal differences were great, but this was due to a shift in consumption from 1 food item to another, rather than the addition or deletion of food items in the nuttall cottontail diet.

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