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Diet similarity between elk and deer in Utah

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DIET SIMILARITY BETWEEN ELK AND DEER IN UTAH

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ABSTRACT.—Growing numbers of elk (*Cervus elaphus*) on winter ranges might adversely affect sympatric wintering mule deer (*Odocoileus hemionus*) if diets of the two species are similar. Diets of elk and deer on a northern Utah range were analyzed for overlap in winter with microhistological analysis of fecal samples. Diets overlapped 71%. No significant difference was found in use of grasses or shrubs between elk and deer; however, use of forbs was significantly different. Shrubs comprised the largest proportion of the diets of both elk and deer. Deer might be under more severe dietary stress than elk on poor winter ranges.

With near extirpation of Rocky Mountain elk in Utah at the turn of the century, mule deer became the dominant wild ungulate (Bryant and Maser 1982). In 1912–1915 elk were reintroduced in Utah with transplanted animals from Jackson, Wyoming. Since then, elk populations have been increasing as a result of sound management practices.

Historically, wintering deer moved to low elevations on valley floors and bordering foothills. Residential, industrial, and commercial development of valleys and bench areas of the Wasatch Front in Utah has restricted mule deer from wintering on ranges to which they were historically accustomed. In the mountainous foothills northeast of Springville, Utah Co., Utah, deer have recently been subjected to another impingement. A herd of elk immigrated onto this very localized range about 20 years ago to winter on the south-facing slopes. The herd has returned annually and now numbers approximately 100 animals.

Before more specific studies provided evidence to the contrary, elk and deer were often classified as grazers and browsers, respectively (DeNio 1938, Gaffney 1941, Cowan 1947). More recent studies have shown that elk and deer diets overlap on occasion (Morris and Schwartz 1957, Mackie 1970, Hansen and Reid 1975). During nonstressful periods, partitioning of food and space occurs; deer use browse and forb species and elk use a preponderance of grass and forb species in separate vegetative communities (Kufeld 1973, Hobbs et al. 1979, Collins and Urness 1983). During periods of snow cover and other limited grazing conditions, both elk and deer can subsist on browse species alone (Cliff 1939, Gaffney 1941, Cowan 1947). The steep slopes of the hills near Springville are dominated by oak-maple-shrub communities interspersed with annual and perennial forbs and grasses (Swenson et al. 1972). The objective of this study was to obtain quantitative measures of association between species and similarity between diets of wintering elk and deer.

METHODS

Dietary composition was determined from microhistological analysis of plant epidermal fragments remaining in feces. From January through March 1983, fecal pellets of elk and deer were collected from the study site only on areas where elk had been observed the same day or a few days earlier to guarantee freshness. Three to five pellets were collected from each defecation of both elk and deer. Sample pellets were collected from several pellet groups across the entire area where animals had been observed to ensure that no individual animal was overrepresented. Ten or more pellet groups were sampled at each area. Pellets were put into plastic bags and frozen until time of processing.

In fall 1983, plants were identified and collected on the study site in quantities sufficient both to press for voucher specimens and to process for tissue reference slides. Reference and test slides were prepared as outlined by Vavra and Holechek (1980). Slides were permanently set in Naphrax High Resolution Diatom Mountant (Northern Biological

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Supplies, Ipswich, England). A 90% accuracy level in identifying epidermal tissue was achieved through training (Holechek and Gross 1982) prior to reading slides of fecal material.

Fecal material was cleared in a solution of 1:2 chlorine bleach and water but otherwise prepared and mounted in the same manner as reference material (Holechek 1982). Chlorine bleach cleared fecal pigments faster than did 0.05M NaOH. A total of 30 slides, 20 fields per slide, were read for each species, representing more than 60 elk defecations and more than 30 deer defecations. Percent frequency was calculated from frequency of occurrence of each plant species identified on slides. Percent frequencies were converted to densities, and from densities to relative densities, which reflect relative amounts of each plant eaten (Todd and Hansen 1973). Overall diet similarity for shared forages was calculated from percent relative densities with the Gauch formula (Gauch 1973, Hansen and Reid 1975). Overlap within each individual forage moiety (grasses, forbs, or shrubs) was also calculated.

Results

Overall diet similarity was 71% among common forage species comprising elk and deer diets. Some relative underestimation of elk use of shrubs might be inherent because elk can browse larger leaders than deer can, which decreases ingested mass in relation to epidermal surface (Gill et al. 1983). Elk and deer diets were 80% similar in shrub species, 49% similar in forbs, and 65% similar in grasses (Fig. 1). Relative densities of each forage moiety in elk diets were 61% shrubs, 6% forbs, and 33% grasses. Relative densities in deer diets were 57% shrubs, 15% forbs, and 28% grasses (Fig. 2).

Forage moieties were significantly associated with elk and deer ($P < .001$) when frequency of occurrence was analyzed in two-way contingency tables. However, when contribution of forbs to the association was removed, shrub and grass use was not significantly different between elk and deer (alpha = .01). Thus, elk and deer diets differed primarily in forb composition, but forbs were the smallest relative contributor to the diets of elk and deer (Fig. 2).

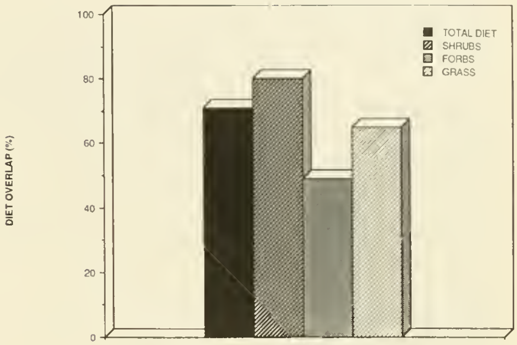

Fig. 1. Percent overlap of entire diet and each forage type for wintering elk and mule deer in Utah, 1983.

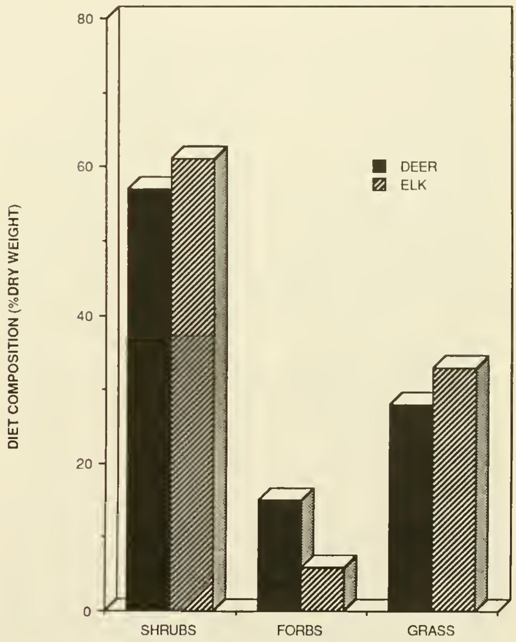

Fig. 2. Dry weight percentage of total diet each forage type contributes to wintering elk and mule deer in Utah, 1983.

Both elk and deer relied largely on shrubs, particularly on gambel oak (*Quercus gambelii*) and sumac (*Rhus* spp.) (Table 1). Both smooth sumac (*R. glabra*) and skunkbrush sumac (*R. trilobata*) were present on the site but could not be discerned separately by epidermal characteristics. Smooth sumac was probably the greater contributor to diets because it was much more abundant. All stands of smooth sumac observed were severely damaged from extensive winter browsing and trampling. Cheatgrass (*Bromus tectorum*)

TABLE 1. Percent relative densities of plant species discerned in feces of elk and mule deer in Utah, 1983.

Forage species	Relative density	
	Elk	Deer
Shrubs		
Acer grandidentatum	9	8
Artemisia tridentata	1	1
Cercocarpus ledifolius	3	<1
Cercocarpus montanus	<1	–
Chrysothamnus nauseosus	–	4
Cowania mexicana	3	3
Quercus gambelii	69	51
Rhus spp.	16	33
Forbs		
Artemisia ludoviciana	6	2
Aster chilensis	21	11
Astragalus utahensis	–	3
Epilobuim canum	–	3
Erigeron divergens	2	1
Eriogonum spp.	5	–
Erodium cicutarium	5	5
Helianthus annuus	13	48
Heterotheca villosa	6	17
Linum lewisii	6	1
Marrubium vulgare	–	3
Oenothera caespitosa	21	3
Petradoria pumilla	–	1
Physalis longifolia	6	–
Xanthocephalum sarothrae	9	3
Grasses		
Agropyron cristatum	15	5
Agropyron intermedium	26	16
Agropyron spicatum	16	7
Aristida purpurea	7	2
Bromus tectorum	14	38
Poa bulbosa	20	31
Sporobolus cryptandrus	1	–

dominated grass species found in the diet of deer, but elk used a variety of grasses (Table 1). Deer also consumed more forbs, especially sunflower (*Helianthus annuus*), than did elk.

Mule deer had a slightly more diverse diet than elk. Deer had a Shannon-Wiener diversity index of 2.33, whereas elk had an index of 2.03.

Overall there was a high similarity (71%) in diets of elk and deer, with little separation in types of forages selected. Forages consumed by elk and deer were of low quality and diversity. Both elk and deer relied most heavily on shrub species, but deer consumed more forbs than did elk. Available forbs were mostly dead, leached annuals from the previous season's growth. Many of the species found in diets of deer are those typical of lower regions of foothills, such as sunflower and cheatgrass.

DISCUSSION

Elk and deer diets overlapped on this winter range for two reasons: (1) vegetative diversity was low, and (2) availability of forbs and grasses was reduced in winter by plant dormancy and snowcover. Elk and deer were forced to select similar forages because availability and choice of forage species were both limited.

We believe that conditions on this range caused competition between wintering elk and deer, but further sampling of snow depth, plant phenology, plant availability, and amount of available forage should be done to define parameters of competition that might exist. If diet overlap is sufficiently extensive and food resources are sufficiently limited and in short supply, resource partitioning must occur in time or space. Nonquantified observations indicate this is true at least for space.

Severe damage caused by deer browsing fruit and ornamental trees is common in areas of Springville and surrounding fields and suburbs. It appears that part of the reason deer are in such close contact with humans is that larger elk on bench areas browse to a level in the shrub canopy that is too high for deer to reach (Rounds 1979). Larger body size allows elk to high-line available browse, move with greater ease than deer do through deep snow (Parker et al. 1984), and directly interfere with deer groupings (Jenkins 1988). The latter was observed on several occasions. Elk are also able to browse shrub and tree leaders with larger diameters, leaving terminals that are too large in diameter for deer to eat.

Larger species typically have greater diversity in prey size and species selection under normal conditions (Mackie 1970, Schoener 1971), but in our study, deer diets were equally diverse or slightly more diverse than elk diets. Since diet diversity often increases under conditions of food resource shortages (Gullion 1966), mule deer probably selected more feeds because they were under dietary stress. Under more favorable conditions deer might have had a less diverse and more specialized diet.

While sampling, we observed dogs, hikers, cross-country skiers, snowmobilers, motorcyclists, and all-terrain vehiclists disturbing wintering animals. Human disturbance during periods of winter stress and poor forage conditions may further reduce survival of wintering elk and deer (Parker et al. 1984). Clearly, further research is needed to more adequately define any competitive interaction between elk and deer; however, managers must be prepared to adjust carrying capacities of one or both species if reduced vigor becomes increasingly manifest in populations in winter.

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