Fecal vs. Rumen Contents to Determine White-tailed Deer Diets

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Abstract

The purpose of this study was to evaluate and determine the feasibility of white-tailed deer (*Odocoileus virginianus*) diet composition of rumen versus fecal contents during winter months in the Black Hills of South Dakota. Sixty-two deer were shot over five winters (December – May). Major plant composition was approximately the same; however, juniper, pine, lichen, and *Astragalus* species showed significant differences between fecal and rumen comparisons. Spearman rank order correlation indicated ranks were in good agreement ($r = 0.82$, $P = 0.01$). Average Kulczynki's similarity was 75 percent overall and is considered very good for major forage species. Significant differences were observed for shrubs and lichen when considering all forage species.. Overall, fecal analyses for major forage species will provide excellent information and help managers make more informed decisions with regard to habitat resources for deer.

Key words: diet composition, methods, microhistological, forage, plants

Introduction

Examination of dietary forage species of herbivores has been accomplished primarily by using the micro-histological technique for many years with procedures developed by Sparks and Malechek (1968). However, few studies have made direct comparisons to better understand herbivore diets by using fecal and rumen contents from the same animal (Smith and Shandruk 1979). Comparisons between esophageal fistula (method to collect forage directly after consumed from esophagus) and fecal have been examined with good results (Vavra et al. 1978, Johnson and Pearson 1981). Smith and Shandruk (1979) reported fewer plant species were identified in fecal samples when compared to rumen contents for pronghorn (*Antilocapara americana*). These studies reported some differences between esophageal fistula and fecal botanical composition to determine diets of herbivores.

Knowledge of dietary food habitats of herbivores is important for resource managers to improve or sustain habitat conditions for the deer. Comparing white-tailed deer (*Odocoileus virginianus*) diets between fecal and rumen content from the same animals within a ponderosa pine forest in the Black Hills of South Dakota is important to improve our understanding of these methods. Micro-histological analyses of fecal samples is the most common method to determine diets of deer (Uresk and Dietz 2017). However, agreement (or not) of botanical composition between fecal and rumen samples has not been documented for the ponderosa pine (*Pinus ponderosa*) forest.

The purpose of this study was to evaluate white-tailed deer diets within a ponderosa pine forest. Specific objectives were to compare fecal with ruman samples from the same individual deer and determine the feasibility of fecal analyses for dietary composition for future and past diet studies.

Study Area

The Black Hills of South Dakota is approximately 5000 km² and ecompasses portions of Wyoming and South Dakota (USDA-Forest Service 1983). Elevation

of the study areas ranged from 1600 m to 1800m. Precipitation during the study period was 51cm and 80% occurs from April to September (Dietz et al. 1980, Uresk and Dietz 2017). Annual precipition since the study is 53 cm (Uresk and Dietz 2017). The average growing season is 89 days and temperatures ranges from -6.2^0 C to 35^0 C.

This study was conducted in two areas, McVey Burn and Experimental Forest dominated by ponderosa pine and a detailed description of the study area is presented by Dietz et al. (1980) and Uresk and Dietz (2017). Common understory shrubs include kinnikinnick (*Arctostaphylos uva-ursi*), chokecherry (*Prunus virginiana*), creeping barberry (*Mahonia repens*), Saskatoon serviceberry (*Amelanchier alnifolia*) and common snowberry (*Symphoricarpos albus*). Graminoids include roughleaf ricegrass (*Oryzopsis asperfolia*), timber oatgrass (*Danthonia intermedia*), sedges (*Carex* spp), Kentucky bluegrass (*Poa pratensis*) and needle-and-thread (*Stipa comata*). Common forbs include cream pea (*Lathyrus ochroleucous*) and bluebell bellflower (*Campanula rotundifolia*). Habitat types and plant species throughout the Black Hills are described by Hoffman and Alexander (1987).

Methods

A total of 62 white-tailed deer were shot in 1967, 1969,1970, 1971 and 1972 (Uresk and Dietz 2017) during 5 winters (December-May). At the time of collection, both fecal and rumen samples were collected from each individual deer. Samples from each deer were kept frozen prior to examination. Individual samples were then thawed, dried, and ground through a Wiley mill fitted with a 1 mm screen. All material was washed over a 0.1-mm screen (Sparks and Malechek 1968). Fecal and rumen material was cleared of chlorophyll and other composites with Hertwig's solution. Microhistological examinations of the samples were examined with 5 slides per rumen and fecal samples. Twenty fields per slide were observed under a binocular microscope at 100 power for identifiable plant fragments (Sparks and Malechek 1968, Rogers and Uresk 1974, Johnson et al. 1981). Hand compounded test mixtures of plants were used periodically to check accuracy of reading slides to determine plant identification and maintain quality control. A 90 percent similarity was maintained between actual test mixtures of plants and estimated values (Rogers and Uresk 1974).

Data from microhistological examination of fecal and rumen contents were reported as percentages of dietary density (Sparks and Malechek 1968). Comparisons between fecal and rumen contents were analyzed using a paired t-test and Spearman's rank order correlation ($P \leq 0.10$) for all food items (SPSS 2003). Kulczynski's similarity index was determined for comparisons of dietary foods (Oosting 1956).

Results

Grasses were dominated by *Poa* spp and *Stipa comata* (Table 1). *Poa* spp were 4 percent and 6 percent in fecal and rumen, respectively, but were not different ($P \leq 0.10$). There were no differences among forage items between fecal (10%) and rumen contents (12%) for grasses and sedges (Table 2). Forbs were similar for the fecal and rumen category. *Astragalus succulentus*, a forb, in fecal and rumen contents was 5 percent and 2 percent, respectively (Table 1). All forbs in the fecal and rument forage contents were similar (Table 2). Shrubs were comparable in both fecal vs rumen contents except for *Juniperus communis*, that was greater ($P \leq 0.10$) in the rumen (1.6%) compared to the fecal (0.5%) (Table 1, Table 2). Shrubs were higher in fecal (69%) versus the rumen (60%) (Table 2, $P \leq 0.10$). Trees were similar in both fecal and rumen contents (Table 2). *Pinus ponderosa*, a tree, was estimated at 10 percent in the rumen compared to 4 percent in the fecal contents (Table 1, $P \leq 0.10$)). Lichen was present in greater amounts within the rumen.

Similarity indices for major forage species ranged from 10 percent to 99 percent

Table 1. White-tailed deer diets (%± SE) comparing fecal vs rumen contents for 62 deer for major plant species or variable that were estimated at >1% of the dietary composition.

Category and Species	Fecal Mean ± SE	Rumen Mean ± SE	Similarity[1] Mean
Grasses and Sedges			
Carex spp.	1.3±0.5	1.8±0.6	84
Danthonia intermedia	0.4±0.2	1.1±0.4	53
Poa spp.	3.7±2.0	5.7±2.0	79
Stipa comata	3.7±1.9	3.6±2.4	99
Forbs			
Antenneria spp.	2.7±1.4	7.1±2.7	55
Astragalus succulentus	5.0±1.6	2.0±0.7*	57
Potentilla geum	2.8±0.7	2.7±0.6	98
Solidago spp.	3.2±1.4	2.4±0.8	86
Trifolium pretense	2.9±2.9	2.3±2.3	89
Shrubs			
Arctpstaphylos uva-ursi	12.2±2.7	11.9±3.8	99
Artemisia frigida	22.8±4.5	16.1±3.7	83
Berberis repens	1.9±1.6	1.3±1.0	81
Juniperus communis	0.5±0.4	1.6±1.2*	48
Rosa woodsii	1.4±0.7	1.9±1.3	85
Rubus pubescens	3.5±1.7	2.6±0.8	85
Salix spp.	18.1±2.6	15.6±2.5	93
Shepherdia canadensis	5.3±1.6	6.3±2.0	91
Trees			
Pinus ponderosa	3.9±0.8	9.6±2.6*	58
Lichen			
Lichen sp.	0.1±0.1	2.0±0.8*	10

* Significant different at $p \leq 0.10$

[1] Kulczynski's similarity index (%).

with an overall average of 75 percent (Table 1). Spearman's rank order correlation was r = 0.82 ($P < 0.01$) indicating that the rankings were alike between fecal and rumen contents.

Discussion

Comparisons between fecal and rumen contents from the same animals have received mixed results (Smith and Shandruk 1979). However, their pooled results for rumen and fecal contents with pronghorns

Table 2. White-tailed deer diets (%± SE) comparing fecal vs rumen contents for 62 deer by category for 49 food items.

Category	Fecal	Rumen	Similarity[1]
	Mean ± SE	Mean ± SE	Mean
Grasses and Sedges	10.3 ± 1.3	12.4 ± 1.4	91
Forbs	16.8 ± 1.4	16.5 ± 1.5	99
Shrubs	68.7 ± 2.7	59.6 ± 2.5*	93
Trees	4.1 ± 0.8	10.0 ± 2.6	58
Lichen	0.1 ± 0.1	2.0 ± 0.8*	10

*Significantly different fecal vs rumen at $P \leq 0.10$.

[1]Kulczynski's similarity index (%).

were 85 percent similar. An evaluation between esophageal fistula and fecal material with cattle was 90 percent similar and highly correlated, r = 0.99 (Johnson and Pearson 1981). Wydeven and Dahlgren (1982) reported that fecal forage species from prairie dogs provide a reasonable estimate of dietary composition when compared to stomach contents.

In our study, *Juniperus communis* and *Pinus ponderosa* were differnet between fecal and rumen content with greater amounts in the rumen. Minson (1990) reported that coarse textured plant fragments spend more time in rumen than fine textured plant fragments. Although, Anthony and Smith (1974) obtained higher values for *Juniperus* spp in fecal than in rumen estimates. Similarly, Johnson and Pearson (1981) obtained greater values for *P. ponderosa* in fecal than in the rumen.

Conclusions

Overall, white-tailed deer fecal analyses for major forage species items provided accurate information when compared to rumen contents to determine dietary composition. Relative densities of major species were approximately the same, although relative density estimates for Juniper and pine, were different ($P \leq 0.10$) between fecal versus rumen comparisons. Spearman's rank order correlation was very good between fecal and rumen contents, r= 0.82 , indicating the ranks were in good agreement for food items. The average similarity index was 75 percent and is considered very good for the major forage species. Fecal analyses will provide resource managers the information required to improve or sustain adequate forage resources for deer.

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