Forage Use By White-tailed Deer In Northwest Montana From An Historical Perspective

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Abstract

We evaluated forage use by white-tailed deer (*Odocoileus virginianus*) that occupy montane forests of northwest Montana over a period spanning the 1940s through the 1990s. Several studies provided food habit information, but most came from the Thompson River, Swan Valley, Kootenai River, and Salish Mountains. Use of Douglas-fir (*Pseudotsuga menziesii*) and Oregon grape (*Berberis repens*) by deer during winter was consistent over the 60-year period despite habitat alteration or loss due to construction of large hydroelectric facilities, logging and other silvicultural treatments, and fire suppression. The relative importance of conifer browse and low-growing species such as Oregon grape probably varied with amount of winter snowpack. Douglas-fir and Oregon grape probably have not represented emergency or starvation forage as traditionally believed but rather a very important dietary component on deer winter ranges in northwest Montana. Availability and use of arboreal lichens by deer might also increase digestibility and importance of browse available to deer during winter. Further, the observed pattern of forage use over time was consistent with a strategy of overwinter survival that favors energy conservation whereby value of overhead cover might override that of forage in winter resource selection.

Key words: forage use, northwest Montana, *Odocoileus virginianus*, white-tailed deer

Introduction

White-tailed deer in the northern Rocky Mountains occupy winter ranges consisting of cutover stands of Douglas-fir along lower valleys and foothills. Human manipulation of these lower-valley montane forests by fire dates back some 6-10 thousand years before Euro-American settlement (Arno 1980, Barrett and Arno 1982). However, a combination of logging and fire from the 1880s to the 1930s altered a large portion of these stands to a mixture of remnant old conifers and second-growth timber dominated by shade tolerant species such as Douglas-fir and shrublands (Pengelly 1963). Additionally, increasingly effective fire suppression through the 1990s probably influenced structure and composition of traditional winter ranges used by white-tailed deer.

Timber harvest with associated road construction has been a primary use of public and corporate timberlands in northwest Montana. From the mid-1940s through the mid-1950s, private and public resource managers maintained that whitetails had exceeded forage carrying capacity on many of these ranges (e.g., Cole 1959) and cited heavy use of conifers as a symptom of overbrowsing (e.g., Adams 1949, Neils et al. 1955). During the 1960s, a common belief held that opening up the forest canopy across the northern tier of the species' range would increase winter browse for white-tailed deer by increasing abundance of shade-intolerant seral shrubs (Krefting 1962, Pengelly 1963). However, short- and long-term effects that logging might have on deer distribution and resource selection were left largely to speculation and an assumption that white-tailed deer depended heavily on early seral communities to meet yearlong forage needs. For example, efforts to mitigate habitat loss resulting from construction of Libby Dam in the early 1970s (Campbell 1971, 1972, Campbell and Knoche 1973) included treating alternative winter ranges to

stimulate growth of deciduous shrubs such as serviceberry (*Amelanchier alnifolia*), chokecherry (*Prunus virginianus*), and bitterbrush (*Purshia tridentata*) to make these sites more attractive to both white-tailed and mule deer (*O. hemionus*).

Hildebrand (1971), Leach (1982), and Mundinger (1984) in the Swan River Valley in northwest Montana and Baumeister (1992) in north-central Idaho reported a close relationship between white-tailed deer and mature, late seral forest. All these studies essentially challenged a concept that categorized white-tailed deer as an animal primarily associated with early succession; these studies and that of Morgan (1993) on summer range in the Salish Mountains suggested that deer preferred mature forests that provided both cover and forage to those that provided either forage or cover alone. In contrast, Hicks (1990) reported that deer preferentially used younger pole-sized timber stands under severe winter conditions in the Thompson River Valley in northwest Montana.

This paper documents forage use by white-tailed deer throughout northwest Montana to determine if such use might have changed in the past 60 years related to (1) a combination of forest management practices and fire suppression policies, and (2) a perceived upward trend in white-tailed deer populations in northwest Montana.

Study Area And Methods

Descriptions of the respective areas and food habit information were previously reported for the Swan-Clearwater by Hildebrand (1971), Janke (1977), and Mundinger (1980) and for the Kootenai in the vicinity of Libby Dam by Campbell (1972). Dusek et al. (2005) described two winter ranges in the Salish Moutains for which Morgan (1993) reported food habits of deer on one of the associated summer ranges.

The early work from the Thompson River included examination of rumen contents of deer found dead in the field, and forage composition was based on weight of consumed material (Montana Fish and Game Department, unpublished). Later analyses of forage use by white-tailed deer, except those for winter in the Salish Mountains, were based on rumen samples collected incidental to the various studies; relative abundance of individual items was determined by an aggregate volume method (Martin et al. 1946).

Winter food habits of white-tailed deer from the Salish Mountains were evaluated from microhistological analysis of fecal composite (Department of Natural Resource Sciences, Washington State University, Pullman) collected on the Bowser and Murphy winter ranges (Dusek et al. 2005) during 1998 and 1999. A sample consisted of three pellets from each of 20 pellet groups. Eight samples were collected, one each during January and February, during 1998 and 1999, from both winter ranges.

Results

The 1940s and 1950s

The earliest known documentation of forage use by white-tailed deer in northwest Montana came from the Thompson River in the early 1940s (Montana Department of Fish and Game, unpubl. data). Douglas-fir occurred in all four rumens examined from the Thompson River during February and March 1942 and was the most abundant item in the diet by average weight (21%). An interpretation of these data hinted at overbrowsing of deciduous shrubs, such as bitterbrush and serviceberry, which managers at that time typically expected to be available to deer during periods of deep snow; this work also reported heavy use of "black lichen" as it became available through blow-down and cuttings. Browsing of conifers by deer was widely documented in northwest Montana by the late 1940s, and managers widely regarded such a foraging pattern indicative of degraded deer range (Adams 1949).

Weckworth (1959) reported consistent use of conifer browse in the Swan Valley from October 1957 through April 1958; among conifer species, deer used Douglas-fir most consistently and most prominently during January and February. He noted that

Oregon grape was the most abundant item in the diet (Table 1) and attributed this to mild winter conditions with relatively light snowfall.

The 1960s and 1970s

Douglas-fir and Oregon grape were major items in the winter diet during the period (Table 1) as reported from rumen analyses of white-tailed deer in the Kootenai drainage following construction of Libby Dam (Campbell 1972) and in the Swan Valley (Mundinger 1980). The relative volume of Douglas-fir in rumens was greatest during periods of heavy snowpack, whereas Oregon grape received its greatest use during years when winter and spring were relatively snow-free.

Managers believed that deer would respond favorably to an increase in shrub production following large-scale timber harvests, but undesirable shrubs would begin to reduce production of "good" browse species within 10-15 years following logging (Pengelly 1961). Treatment of forested communities to stimulate increased abundance and nutritional quality of seral shrubs considered to be important to deer dominated early efforts to mitigate loss of winter range along the Kootenai although Campbell (1972) noted that deer continued to rely primarily on Douglas-fir, other conifers, and other taxa that retained chorophyll through winter, e.g., Oregon grape and horsetail (*Equisetum* spp.).

The 1980s and 1990s

Winter.—Foods used by white-tailed deer on the Bowser and Murphy winter ranges during the relatively mild winters of 1998 and 1999 (determined from micro-histological analysis) are summarized in Table 2. Browse, including both conifers and deciduous species, accounted for about 91 percent of the winter diet (Table 2). Oregon grape and Douglas-fir were by far the most abundant items occurring among samples across both areas during both years. Their combined use accounted for an average of 79 percent among all winter samples (Table 2). Abundance of other browse species was low although willow (*Salix* spp.) and lodgepole pine (*Pinus contorta*) consistently occurred in the diet both spatially and temporally. Grasses and grass-like plants accounted for about 5 percent of the winter diet. Lichens occurred among samples for both years and from both winter ranges. These most likely represented two genera of lichens occurring in the *Pseudotsuga menziesii* Series (Eversman, personal communication 2004): *Bryoria* spp. and *Usnea* spp. Project personnel observed deer using Bryoria either from camera surveys or by direct observation. Periodic winds seemingly increased availability of this taxon through blow down.

Spring/summer/autumn.—Food habits of white-tailed deer for spring-autumn 1989 and 1990 were previously reported by Morgan (1993) for a portion of the Salish Mountains that included the Tally Lake District of the Flathead National Forest (Fig. 1). These findings offer additional evidence that browse dominated the yearlong diet of white-tailed deer in northwest Montana. Based on forage items used by deer during this period, these data further emphasized that deer foraged consistently under the forest canopy even during spring-autumn and probably made less use of early seral deciduous shrubs than one might expect.

Browse received less use during spring than in other seasons but still accounted for nearly half of the spring diet. During spring, grasses received their only significant use and accounted for most of the remaining volume among rumen samples (Fig. 1). The average volume of forbs among rumens increased from spring to summer and then declined from summer to autumn. Rumen samples for the autumn period were taken prior to 15 October; as such, these data reflect forage use only during early autumn and not that of late autumn when deer would probably increase their use of taxa that typically occur in the winter diet.

Among shrubs that contributed to the spring-autumn diet of deer in the Salish Mountains (Morgan 1993), pachistima (*Pachistima myrsintes*) accounted for $\geq$ 21 percent by volume among rumen samples collected during spring, summer, and autumn.

Table 1. Summary of winter food habits of white-tailed deer in Northwestern Montana from rumen analysis.

Study	Forage Class Composition (% of diet)				Top 5 species in the diet ranked by volume				
	Browse	Grasses	Forbs	Nonvascular	1	2	3	4	5
MDF&G 1942 (n = 3)[1]	71	9	0	13	Kinnikinnick	Douglas-fir	Lichen	Lodgepole pine	Other conifers
Weckwerth 1959 (n = 23)	91	2	7	0	Oregon grape	Twin -flower	Douglas-fir	Kinnikinnick	Pachistima
MDF&G 1950-70 (n = 62)	78	9	10	1	Oregon grape	Douglas-fir	Serviceberry	Equisitium	Lodgepole pine
Hildebrand 1971 (n = 23)	84	7	7	1	Oregon grape	Douglas -fir	Lodgepole pine	Ponderosa pine	Snowbrush ceanothus
Campbell 1972 (n = 16)	72	18	9	1	Douglas-fir	Oregon grape	Ponderosa pine	Cottonwood	Western larch
MDF&G 1970-75 (n = 91)	48	37	10	1	Equisitium	Douglas-fir	Oregon grape	Ponderosa pine	Serviceberry
Mundinger 1980 (n = 106)	91	2	5	2	Douglas-fir	Oregon grape	Lodgepole pine	Spruce	Common juniper
This Study[2]	91	5	2	2	Oregon grape	Douglas-fir	Willow	Lodgepole pine	Lichen

[1] Number of rumen samples collected
[2] Winter food habits from this study were from microhistological analysis (see Table 2).

Its use increased during spring through mid autumn. Other browse species used consistently throughout the spring-autumn period but accounted for ≤ 1 percent of the average volume for each season included huckleberry (*Vaccinium* spp.), Douglas-fir, princes-pine (*Chimaphila umbellata*), and serviceberry. Princes-pine and huckleberry received their greatest use during summer compared to spring and autumn.

Discussion

Our examination of forage use by white-tailed deer throughout northwest Montana over the past six decades leaves little doubt that second growth Douglas-fir in the foothills and lower drainages has provided key winter range for white-tailed deer in western Montana as suggested early on by Pengelly (1963). It is important to note that the predominance of Douglas-fir and Oregon grape in the winter diets of white-tailed deer was consistent in food habit studies from the 1940s through the 1990s (Tables 1 and 2). This time frame transcends a period of significant change in the forests of northwestern Montana including marked habitat loss resulting from construction of several large hydroelectric dams. Harvest patterns and fire exclusion have converted much of the late-seral forest communities to mid-seral forest communities, while invasion of noxious weeds has rapidly displaced native species throughout the

Table 2. Winter foods of white-tailed deer in the Salish Mountains, 1998-1999, from microhistological analysis of pellets from four sites across each winter range.

Deer Diets	BTWR	BTWR	MDWR	MDWR	Overall	
Plant species[1]	1998	1999	1998	1999	Mean	Rank
Berberis repens (leaf)	58.10	33.43	52.23	53.28	47.29	1
Pseudotsuga menziesii	26.18	43.89	30.45	22.13	31.44	2
Salix spp. (stem)	0.85	2.30	0.83	2.23	1.79	3
Pinus contorta	0.83	1.45	3.80	1.23	1.66	4
Lichen	1.85	1.88	1.83	1.00	1.57	5
Poa spp.	0.63	1.73	0.08	2.40	1.49	6
Amelanchier alnifolia (stem)	0.00	1.01	0.75	1.60	1.00	7
Shepherdia canadensis	0.00	1.60	0.75	0.99	0.99	8
Vaccinium spp. (leaf)	0.28	0.40	0.48	1.83	0.87	9
Carex spp.	0.75	0.73	0.20	1.40	0.87	9
Salix spp. (leaf)	1.50	0.14	0.23	1.29	0.76	11
Moss	0.55	0.70	0.00	1.21	0.73	12
Juniperus spp.	0.98	1.23	0.08	0.33	0.69	13
Cornus stolonifera (leaf)	0.45	0.19	1.05	0.98	0.64	14
Other Shrub (stem)	0.08	0.98	0.63	0.55	0.63	15
Other grasses	0.83	0.83	0.23	0.29	0.55	16
Other forbs	0.60	0.36	0.78	0.51	0.52	17
Total	100.00	100.00	100.00	100.00	100.00	
Forage Class						
Total Conifers	28.60	48.38	34.55	23.74	34.56	
Total Shrub	61.78	42.53	60.78	64.85	56.22	
Total Grass	4.43	4.93	0.50	5.18	4.19	
Total Sedge/Rush	0.75	0.83	0.20	1.40	0.90	
Total Forb	1.75	0.73	1.63	2.09	1.50	
Total Ferns	0.10	0.00	0.43	0.04	0.10	
Nonvascular plants	2.40	2.58	1.83	2.21	2.30	

[1]Includes only those plants that comprise ≥ 0.5 % of the overall winter diet.

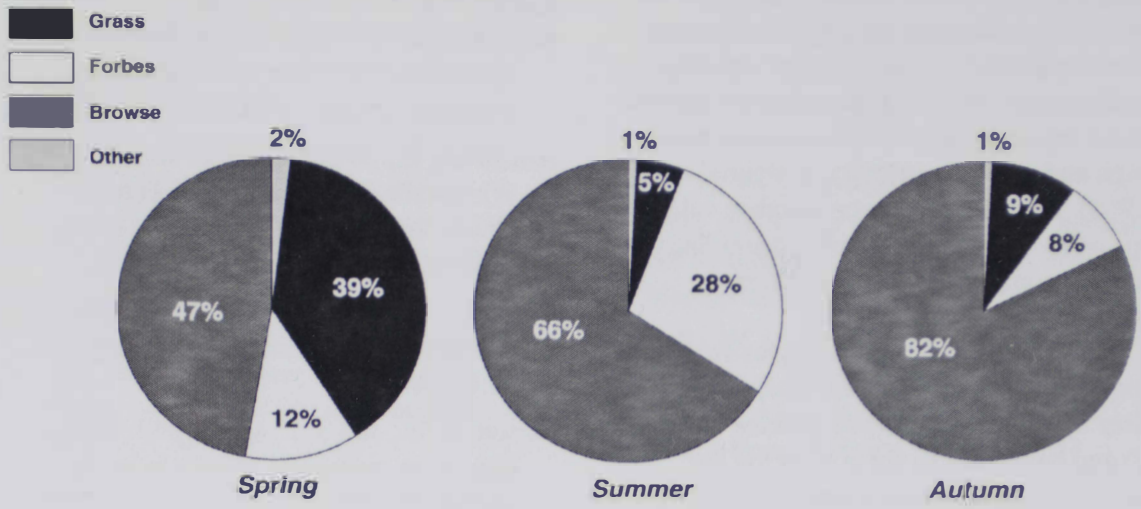

Figure 1. Use among forage classes by white-tailed deer in the Tally Lake District during Spring-Autumn based on data reported by Morgan (1993). Relative use of each forage class is expressed as a percent of the average total volume.

Pacific northwest (USDA Forest Service 1996). Douglas-fir and Oregon grape continue to dominate winter diets of deer, despite the extensive changes in forest structure and composition over the last 60 years. This, together with an upward trend in deer harvests (Dusek et al. 2005) over the same period suggests that these forage species do not and probably never represented emergency or starvation rations, but probably represented an important dietary component available to deer on winter ranges in this region.

Although early efforts to increase browse production through timber harvest, low-intensity burns, or other silvicultural treatments were based on a premise that deer would respond favorably to fragmenting continuity of forest canopy on winter ranges, such practices may have only reduced the shelter value of the habitat. For example, in Ontario deer did not noticeably respond to increased availability of browse following opening the canopy to develop cottage sites suggesting that shelter quality probably outweighed browse availability (Armstrong et al. 1983). Pauley et al. (1993) explained and predicted winter habitat selection in the context of energy budget for white-tailed deer in northern Idaho. Thus, when snow depth was < 30 cm deer strongly selected for lodgepole pine and Douglas-fir pole stands that provide relatively minimal snow interception and an abundance of 'preferred' forage (Pauley et al. 1993); however, during mid winter when snow depths often exceeded 40 cm, deer avoided openings and early successional stands and selected advanced forest age classes that provided more optimal snow conditions. Under such conditions we would expect white-tailed deer to increase their use of Douglas-fir and other browse that was readily available.

Although lichens occurred only as a small proportion of the total winter diet, they were a disproportionately important component of the winter food supply because of the synergistic effect they have on rumen function. High levels of digestible energy found in lichens increases the concentration of rumen protozoa many-fold, which results in an increased net utilization of nitrogen from other forage species (Ullrey et al. 1971). Studies of penned deer also found that a combination of energy and nitrogen supplements to a browse diet, although not changing overall digestibility of native forage species, significantly increased total forage intake when the supplement comprised as low as 10 percent of total dry matter intake (Ullrey et al. 1975). Thus, consumption of

lichen likely increases nutritional status of wintering deer by increasing overall rumen function. Lichens also might be typically under-represented in dietary studies such as those reported in Table 1 because of their high and rapid digestibility (Bergerud et al. 1964). They are of disproportionate value in the winter diet of white-tailed deer relative to their composition in overall forage consumption.

Oregon grape and/or Douglas-fir are major winter food items for white-tailed deer in northwest Montana (Tables 1 and 2) and have been so for at least the last 60 years. Similar dietary patterns have been documented in the lower Clearwater-Blackfoot drainages of western Montana (Janke 1977, Slott 1980). Campbell (1972), Janke (1977) and Mundinger (1980) reported predominance of Oregon grape in the diet of deer in the Kootenai and Swan valleys during either mild winters with below-average snowfall or the portion of individual winters in which snowpack was minimal or absent; Douglas-fir dominated deer diets during periods of heavier snow accumulation. Thus, we conclude that the effect of winter snowpack on availability of Oregon grape determines forage selection between two primary forage species. These studies all point to a strategy of overwinter survival of white-tailed deer in northwest Montana that favors energy conservation whereby deer tend to be habitat specialists and forage generalists.

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