UNGULATE BROWSING ON 2-YEAR-OLD GROWTH OF SHRUBS ON A BOREAL MIXEDWOOD WINTER RANGE IN SOUTHWESTERN MANITOBA

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Abstract: Moose (Alces alces), elk (Cervus elaphus) and white-tailed deer (Odocoileus virginianus) were tracked in snow to sites of intensive feeding during late winter on a Boreal Mixedwood range in southwestern Manitoba. About 40% of the recorded bites for moose and elk on twigs of hazelnut (Corylus cornuta) terminated in 2-year-old wood. On average only 10% or less of the bites on aspen (Populus tremuloides), saskatoon (Amelanchier alnifolia), red osier (Cornus stolonifera), choke cherry (Prunus virginiana), and pin cherry (Prunus pensylvanica) terminated in 2-year-old wood. White-tailed deer seldom browsed other than current twig growth. Hazelnut was the most abundant food item on the range and the primary food item in ungulate diets. The relevance of these results to assessing range carrying capacity, range nutrition, range utilization, and foraging niches of ungulates is discussed.

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One of the critical questions which must be addressed in evaluating ungulate range relationships is - what is ungulate food? Determining range condition in relation to population density, or estimating range carrying capacity based on biomass and nutrition parameters, depends on the ability of the researcher or range manager to correctly identify the parts of the standing crop of vegetation which animals choose as forage.

In order to identify key forage, state of the art range management relies on: (1) diet studies, and (2) forage preference surveys which assess browse incidents on plants in relation to the total array of plants available.

A common assumption incorporated in range evaluations is that current annual growth of forage species constitutes the bulk of the usable food. However, when scientists examine freshly browsed plants along feeding trails of both tame and wild ungulates, or closely observe feeding behaviour in the field, it is obvious that there is great selectivity shown by these animals for certain plant species, growth forms, individual parts, and growth stages (Ahlen 1968, Regelin et al. 1974, Hobbs et al. 1981). Because of this, range researchers are investigating the relationship of palatability and forage selection particularly in relation to occurrence and concentration of secondary compounds, nutritional content, and digestibility (Ahlen 1968, Bryant 1981, Bryant and Kuropat 1980, Bryant et al. 1983).

An important component of range research and management will always be what ungulates ultimately eat in terms of twig growth. In this paper I describe an aspect of the browsing behaviour of moose, elk and white-tailed deer in relation to some key shrub species on winter range in Riding Mountain National Park, Manitoba. The data were collected on an opportunistic basis and are not extensive; however, I feel they are worth presenting in this forum as there are few references on moose browsing behaviour in the Boreal Mixedwood Forest of western Canada, an important moose range. Likewise, there is limited information for this region where moose share the range with other ungulates.

THE STUDY AREA

Riding Mountain National Park is a wildlife refuge in southwestern Manitoba consisting of heavily forested, rolling upland completely surrounded by farmland. Minor inclusions of Aspen Parkland with Rough Fescue (Festuca scabrella) Grassland and Eastern Deciduous Forest occur within the predominantly Mixedwood Forest. Logging and extensive fires during settlement depleted softwood timber, created extensive pure stands of aspen and balsam poplar (Populus balsamifera), and increased the abundance of upland shrubs. Poorly drained areas support sedge (Carex spp.) and treed fens, black spruce (Picea mariana) bogs, or sedge and sedge-willow (Salix spp.) meadows.

The dominant shrub of upland forests and shrublands is beaked hazelnut. In order of approximate abundance, as determined by shrub stem density surveys, the conspicuous upland shrubs are hazelnut - 75%, choke cherry - 5%, prickly rose (Rosa acicularis) - 4%, wild red raspberry (Rubus strigosus) - 3%, beaked willow (Salix bebbiana) - 1%, saskatoon - 1%, balsam poplar - 0.5%, snowberry (Symphoricarpos albus) - 0.5%, and sporadic occurrence of red osier, pin cherry, mountain maple (Acer spicatum) and 14 other shrubs totalling near 10% (Trottier et al. 1983).

METHODS

Moose, elk and white-tailed deer were tracked along feeding trails in winter during a study to determine foraging and habitat selection characteristics (Trottier et al. 1983). Ungulates were backtracked to sites of intensive feeding where twigs browsed by the animal being

tracked were counted (Knowlton 1960). During these surveys I observed that moose in particular were commonly consuming all the current annual growth plus a proportion of the previous year's growth of twigs on some shrubs; therefore, I began to record whether bites terminated in current annual growth or older growth.

At each feeding site examined in late winter 1980 every browsed twig recorded was classified as either: (1) bite terminating in current annual growth, or (2) bite terminating on previous year's growth. Subsequently, the proportions of these categories in relation to total bites were calculated. The calculated proportions for each plant species were combined for all feeding sites of a particular animal species to calculate means. Differences in means were tested by ANOVA (Snedecor 1956) or by Student's t-test depending on the hypothesis being evaluated.

Appearance of the bark and bud scale scars were used to distinguish current and previous year's twigs. Current twigs have thin, smooth bark, are often pubescent and lack lenticel development. Older twigs have thick, corky bark often rough or cracking, developed lenticels, and bud scale scars. Since these data were not collected until late in the third year of the study, sample sizes for the less common forage species were low and this limited statistical analysis for some shrub species.

The hedge class condition of shrubs was evaluated at selected range trend sites within the study area (Trottier et al. 1983), and this information was used to evaluate whether forage plant condition influenced browsing behavior. Range condition surveys were conducted using the hedge class criteria and methods of Cole (1963). Range trend sites were located on winter range continuously used by ungulates, as indicated by aerial surveys, and included a variety of forest habitat types. Ten

homogenous stands were selected using aerial photographs. A point within each stand was subjectively chosen and marked with flagging. A base line intersecting that point was set along a randomly chosen cardinal compass bearing. The base line was subdivided by stations spaced at 10 m intervals and five of these stations were randomly selected as sample transect lines. Five permanently staked quadrates (1 m x 1 m) were placed at 20 m intervals along each sampling line and all plants in the quadrates were assigned a hedge class rating. Range sites were sampled in May after snow had disappeared.

RESULTS

Moose, elk and white-tailed deer browsed previous year's woody growth of most forage items. On average about 10% of the total bites included previous as well as current year's growth, except for hazelnut and red osier (Table 1). Moose and elk browsed significantly more, up to 40% of the bites, on previous year's wood of hazelnut ($P < 0.01$).

There was no difference in the feeding behaviour of moose and elk on respective forage species except that moose browsed significantly more often into previous year's growth of saskatoon than did elk ($P < 0.05$). Conversely, white-tailed deer did not frequently browse into old growth wood of any forage species although they occupied the same range as moose and elk.

Hazelnut, aspen, saskatoon, balsam poplar and choke cherry were key browse species on the Riding Mountain winter ranges, but only hazelnut was in excellent condition (Table 2). Hazelnut is by far the most abundant forage species on the range and was the chief browse item in the

Table 1. Winter browsing by moose, elk and white-tailed deer which involved utilization of previous year's growth (PYG), Riding Mountain National Park, 1979-80.

Browse species	Mean proportion of bites on twigs which terminated in PYG (%)									
	Moose			Elk			White-tailed deer		
	$\bar{X}$	± SD	Number of bites	$\bar{X}$	± SD	Number of bites	$\bar{X}$	± SD	Number of bites
Aspen	7.6 ± 15.0^{A}		182	8.1 ± 11.6^{A}		285	1.3 ± 2.3		51
Balsam poplar	7.0 ± 8.8		83	6.3 ± 10.8		67	-		
Choke cherry	10.7 ± 11.9^{B}		253	16.3 ± 12.6^{B}		791	2.1 ± 3.0		27
Hazelnut	42.3 ± 15.2^{C}		4819	37.5 ± 22.8^{C}		2298	8.3 ± 12.2^{C}		7602
Pin cherry	2.9 ± 4.2		27	11.1 ± 19.3		8	no data		
Red osier	100		10	100		152	0		11
Saskatoon	17.3 ± 14.4^{D}		46	8.8 ± 9.6^{D}		493	0		44

ABCD - Tested column means significantly different (one-way ANOVA, $P < 0.01$).
A-A, B-B, D-D - Tested row means not significantly different (Student's t-test, $P < 0.05$).
C-C-C - Tested row means significantly different (One-way ANOVA, $P < 0.01$).

Table 2. Hedge class condition of selected tall shrubs (51-250 cm high) on ungulate winter range in Riding Mountain National Park, 1980 and 1982. Pooled sample; plants from ten permanent transects were combined.

Shrub taxa	No. of plants examined	Proportion of plants in hedge class[1] A	B	C	D	Condition[2]
Hazelnut						
1980	1187	73	24	2	1	Excellent
1982	1073	67	24	5	4	Excellent
Choke cherry						
1980	91	52	23	20	5	Fair
1982	81	38	22	26	14	Poor
Saskatoon						
1980	144	41	30	23	6	Fair
1982	161	22	18	42	18	Very poor
Aspen						
1980	16	19	12	56	13	Very poor
1982	4	0	25	50	25	Very poor

[1]Hedge class definitions: A = zero-light, B = moderate, C = severe, D = decadent (Cole 1963).

[2]Condition rating is based on proportion of stems in class C and D; Excellent = 0-10%, Good = 11-20%, Fair = 21-30%, Poor = 31-50%, Very poor > 50% (Cole 1963).

winter diets of all ungulates (Trottier et al. 1983). Saskatoon and choke cherry were in fair condition when the feeding sites were examined in 1980 and aspen was in very poor condition. Range condition deteriorated between 1980 and 1982; however, browsing behavior was not studied after 1980 to determine if the use of older growth wood changed proportionally as the condition of range plants deteriorated.

DISCUSSION

These data suggest that browse utilization by moose and other ungulates on Boreal Mixedwood range can be significantly different over the spectrum of key forage species. They also illustrate subtle differences in ungulate foraging niches.

Chemical composition determinations for browse forage are generally run on samples collected by two recommended methods: (1) clipping plant parts as samples which simulate the feeding activities of the animal species of interest (Ahlen 1968, Nagy and Haufler 1980), or (2) collecting the current annual growth (Nagy and Haufler 1980). The data presented here indicate that one should at least monitor nutritional status of wood older than current growth of hazelnut, a key ungulate forage species in the Boreal Mixedwood range, if range quality and carrying capacity are to be determined. On the other hand, it may not be necessary to sample beyond current annual growth for species such as aspen, balsam poplar, choke cherry, pin cherry, saskatoon, and red osier if plants are moderately to severely hedged. If these latter species are not hedged, then previous year's growth will be readily available and may be eaten.

There was little apparent use of old growth wood on those plant species which were in fair to very poor condition. In contrast, much use was made of previous year's growth of hazelnut plants which generally were in excellent condition. On severely hedged plants there is little residual two-year-old growth (Cole 1963) which in turn limits the browsing opportunity to larger diameter three-year-and older growth.

I should point out that the range condition survey for the study area was conducted on permanent transects and not on the plants examined at the feeding sites. I recommend that further studies of this kind should rate the hedge class condition of each browsed plant examined along feeding trails and run correlations between occurrence of browsing on older wood and hedge class condition.

Available browse biomass on ranges is generally sampled by harvest or indirect methods. These include either the harvest of current annual growth only, the Shafer (1963) twig count, or the stem diameter-length-weight relationship (Basile and Hutchings 1966, Telfer 1968). If the two latter methods are adopted the preferences of the browser for actual plant parts will be accounted for in the available biomass estimate. If however, the investigator chooses the direct harvest method then he must take into consideration that moose, and also sympatric ungulates, utilize different ages of annual woody growth depending on the individual browse species and hedge class condition of the plants.

Contemporary browse utilization surveys include: (1) counting or estimating proportion of browsed twigs (Cole 1963), (2) the twig-length method (Nelson 1930, Smith and Urness 1962), or (3) the Shafer twig count (Shafer 1963, Telfer 1968). If the Shafer method is used the animal's bias for particular plant parts is adequately measured. If the

proportion of twigs browsed method is used this bias is inconsequential. However, if the twig-length method is used problems will arise where current year's growth on some twigs is completely removed and some previous year's growth consumed because the technique consists of comparing total length of current year's growth before and immediately after the browsing season. This method would be difficult to apply on the Riding Mountain range because a large proportion of the current annual growth on browsed plants is totally consumed. Results would therefore suggest overutilization when in fact suitable forage was still available.

The data on browsing behaviour reveal a subtle difference in the foraging niches of moose and elk compared with white-tailed deer. Deer appear to limit forage selection to younger, possibly more palatable woody growth indicating that they are characteristically fine, selective foragers. Current year twigs are relatively more digestible because they contain less lignin than older growth twigs (Oldemeyer et al. 1977). Therefore, deer likely take food which contains less undigestible dry matter to offset the limitations of their digestive system and small body size (Ammann et al. 1973, Moen 1973, Short 1975, Hudson 1981). On range depleted by an overstocked moose population it is possible that the foraging efficiency of deer would be reduced. Keeping in mind that the moose population in Riding Mountain National Park has increased from a low of 500 in 1950 to a current high of 2,800 it will be informative to monitor range condition to determine if competitive conditions develop between moose (also elk) and white-tailed deer.

CONCLUSIONS

I have presented these data to illustrate the need for caution in designing and interpreting range studies in the Boreal Mixedwood region of western Canada. Herbivores are selective in their choice of foods, not only for plant species, but also for certain plant parts. It may be sufficient to consider the current annual growth of some key shrub species as an indicator of range carrying capacity; however, if the primary food used is hazelnut, at least the two-year-old wood should be included in determinations of available biomass. A range condition reconnaissance should be conducted prior to deciding which methods will be adopted to assess available biomass, forage utilization, and forage nutritional status. It would be inadequate to assume that current annual growth is the sole usuable source of browse on these ranges.

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